Post-Fire Aerial Application of Herbicide Environmental Assessment

ZION NATIONAL PARK

Summary

The National Park Service (NPS) proposes the aerial application of herbicide on the area burned in the 2007 Dakota Hill Complex Fires and a reapplication of herbicide on areas burned in the 2006 Kolob Fire within Zion National Park. The intent of the aerial application of herbicide is to interrupt the grass-fire cycle that is perpetuated by invasive annual grasses.

The non-native invasive annual grasses increase in abundance and density after fire, resulting in increased fuel loads and fuel continuity, which in turn create a receptive environment for future fires. As these non-native grasses continue to invade and increase after each fire, the time between fires becomes shorter.

A treatment is needed to interrupt the non-native grass-fire cycle that has already been established, but has not yet eliminated the native seed beds. This interruption should reduce non-native grass establishment over many growing seasons, thus allowing the native plants to successfully re-establish and persist in the burned area. The re-establishment of native vegetation would then restore habitat needed to support native wildlife and perpetuate natural ecosystem processes.

Action to interrupt the grass-fire cycle is being proposed in response to the Dakota Hill Complex and Kolob Fires. The Dakota Hill Complex was ignited by lightning on July 15, 2007 and burned 9,112 acres, including 5,858 acres of NPS land in the northeastern portion of the park. The Kolob fire was human-caused fire started on June 24, 2006 and over the next six days burned a total of 17,632 acres, including 10,506 acres in the southwest corner of the park. This was the largest fire in the park's history, and is equal to the total number of acres that have burned in park since 1950.

Alternative A (No Action): Under the No Action alternative, the aerial application of herbicide would not occur and the park would continue with existing management actions in the burned area. Over time the no action alternative would most likely lead to perpetuation of the grass-fire cycle. It is expected that non-native grasses would quickly re-invade the burned area, with dense stands of non-native grasses most likely to be established in the next few years along roads, trails, and the boundary of the park.

Alternative B (Proposed Action/Preferred Alternative): The proposed action is the aerial application of herbicide on up to 3,161 acres within the 2007 Dakota Hill Complex fire and a re-application of herbicides on up to 6,739 acres burned in the 2006 Kolob fire. The purpose of the herbicide application is to inhibit cheatgrass germination and growth, which would interrupt the grass-fire cycle and thereby restore native plant communities and wildlife habitat.

NOTE TO REVIEWERS AND RESPONDENTS

Before including your address, phone number, e-mail address, or other personal identifying information in your comment, you should be aware that your entire comment - including your personal identifying information - may be made publicly available at any time. While you can ask us in your comment to withhold your personal identifying information from public review, we cannot guarantee that we will be able to do so.

Please send comments by October 5, 2007 to: Zion National Park, Attn: Post-Fire Aerial Herbicide EA, Springdale, UT 84767

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Purpose and Need

The purpose of the aerial application of herbicide analyzed in this Environmental Assessment (EA) would be to contribute to the restoration of natural fire regimes and ecosystem processes in the areas burned inside Zion National Park (ZION) by the 2007 Dakota Hill Fire Complex. This EA will also analyze the impacts associated with re-treatment of some areas burned in the 2006 Kolob Fire. This action would further goals and desired future conditions identified in the General Management Plan (GMP) (NPS 2001b) and Fire Management Plan (FMP) (NPS 2005):

- GMP Mission Goal: Maintain the resource, including plant and animal communities, at healthy and viable levels consistent with natural processes.
- FMP Goal: Prevent and suppress unwanted fires using effective strategies and methods under the decision process of sound risk management.
- FMP Desired future condition: Vegetation succession reflects the natural range of variability under conditions that would occur under historical fire regimes.
- FMP Desired future condition: Native wildlife habitat is maintained, restored, or enhanced through fire management practices that are consistent with natural processes.

The intent of the aerial application of herbicide is to interrupt the grass-fire cycle (Brooks et al. 2004, D'Antonio and Vitousek 1992) that is perpetuated by invasive annual grasses collectively referred to in this document as "cheatgrass," including *Bromus tectorum*, *Bromus rubens*, *Bromus diandrus*, and *Bromus japonicus*. Non-native cheatgrass increases in abundance and density after fire, resulting in increased fuel loads and fuel continuity, which in turn create a receptive environment for future fires. As cheatgrass continues to invade and increase after each fire, the time between fires becomes shorter. Since the native shrubs and trees are slower to re-establish after fire and need many years between fire events to complete their lifecycles, the increased fire frequency fueled by cheatgrass eventually eliminates most of the native shrubs and trees from the landscape. Cheatgrass also displaces the native grasses and herbaceous (non-woody) plants because as a winter annual, cheatgrass is able to establish earlier in the growing season than most native grasses and herbaceous plants. In this way, cheatgrass depletes soil moisture and competes against the native species until the native species are eventually crowded out of large areas as the grass-fire cycle continues. Similar to its effects on shrub and tree species, grasses and herbaceous species that are intolerant of frequent fire are eventually eliminated from the landscape by the fires carried by cheatgrass. As the grass-fire cycle is perpetuated, the fire frequency increases, eliminating native species adapted to a longer fire return intervals.

A treatment is needed to interrupt the grass-fire cycle while there are still native plants and seeds in the area. This interruption should reduce cheatgrass establishment over a few growing seasons, allowing the native plants to successfully re-establish and persist in the burned area. The re-establishment of native vegetation would then restore habitat needed to support native wildlife and perpetuate natural ecosystem processes.

Action to interrupt the grass-fire cycle is being taken at this time in response to the 2007 Dakota Hill Complex and 2006 Kolob fires. The Dakota Hill Complex fire, ignited by lightning on July 15, 2007 burned a total of 9,112 acres, including 5,858 acres in ZION. The human-caused Kolob fire started on June 24, 2006 and burned a total of 17,632 acres, including 10,506 acres in ZION. The Kolob fire was the largest fire in the park's history, and almost surpassed the total acres burned in the park since 1950. The vegetation in the burned areas for both fires primarily consists of pinyon-juniper woodland, ponderosa pine, mountain shrub, and shrublands. While there were many in-tact native plant communities in the burned areas prior to the fires, there were also populations of cheatgrass that served to carry the fire.

Dense stands of cheatgrass continue to persist immediately adjacent to the burned area on the Kolob fire, particularly to the north along the Kolob Terrace Road and along the west boundary of the park, as well as in the interior of the burned area where pockets of unburned vegetation persist. The Dakota Complex experienced a mosaic burn. Cheatgrass was present in the understory of the pinyon/juniper and shrub canopies. The National Park Service (NPS) is concerned that these seed sources, coupled with the cheatgrass seeds that remain in the soil in the burned area, would allow the cheatgrass to quickly re-establish and flourish in the burned area. Such an event would be highly detrimental to the recovery of native plants in the burned area and would result in long-term habitat degradation as the grass-fire cycle would gain in strength and persist for many years to come. The best opportunity to prevent the establishment of cheatgrass is in fall/winter of 2007/2008, when herbicides could be applied at a landscape level to prevent germination and growth of cheatgrass in the winter and early spring, thus allowing the native plants an opportunity to re-establish themselves in the burned area. For these reasons, ZION feels compelled to take action now to restore and preserve the natural vegetation communities in the Dakota Hill Complex and Kolob fires burned areas.

Location and Description

ZION is 148,024 acres in size and is located on the southwestern edge of the Colorado Plateau (Figure 1). The park lies in portions of three counties in Utah — Washington, Iron, and Kane. The northwest corner of the park is approximately 260 miles southwest of Salt Lake City, Utah. Interstate 15 is located to the west of the park. High plateaus, a maze of narrow, deep sandstone canyons, and striking rock towers and mesas characterize the park. The lowest elevation in the park, 3,666 feet, is found at Coalpits Wash in the southwest corner of the park and near area that burned in the Kolob fire. The highest elevation, 8,726 feet, is Horse Ranch Mountain in the Kolob Canyons section to the north and east of the burned areas.

The Dakota Hill Complex fire project area (Figure 1) is located in the northeast corner of ZION (East fire) and on the southern end of Horse Pasture Plateau (West fire). The East fire burned in watersheds immediately south and east of the North Fork of the Virgin River and north of Orderville Canyon. The landscape of the burned area is characterized by deeply incised canyons and isolated mesa tops that include areas of shallow soils. Elevation ranges from about 6,800 feet on the East fire near the northeastern boundary of the park to about 7,300 feet on Horse Pasture Plateau on the West fire.

The Kolob fire project area (Figure 1) is located in the southwest corner of ZION. The fire primarily burned lands in the North Creek watershed of the Virgin River, approximately 5 miles northeast of Virgin, Utah. The landscape of the burned area is characterized by highly eroded badlands, steep rock land that includes areas of shallow soils and nearly vertical sandstone cliffs, mesas, incised canyons with relatively narrow floodplains and stream terraces, and volcanic cinder cones and basalt lava flows. Elevation ranges from about 3,600 feet near State Route 9 at the southern end of the fire to about 6,900 feet in the northeastern part of the fire.

Figure 1

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Relationship to Other Plans

This EA is in conformance with and tiered to the following approved plans:

- General Management Plan for Zion National Park
- Fire Management Plan for Zion National Park
- Dakota Hill Complex Burned Area Rehabilitation Plan
- Kolob Fire Burned Area Rehabilitation Plan

The ZION GMP, completed in 2001 (NPS 2001b), identified zones that define how different areas of the park will be managed to achieve desired resource and social conditions and to serve recreational needs. The park is divided into seven zones: Frontcountry High Development, Frontcountry Low Development, Transition, Primitive, Pristine, Research Natural Areas, and Administrative. The majority of the project area (Dakota Hill East and Kolob) occurred in lands zoned as Pristine. Dakota Hill West and the trail corridors in the Kolob area are zoned as Primitive. The Kolob Terrace Road corridor and the Lava Point helispot are zoned as Frontcountry Low Development. The Coalpits helibase is zoned Administrative. These four zones are defined below.

The **Pristine Zone** (9,119 acres in the project area) encompasses remote expanses of land within the park. The zone emphasizes a natural landscape, free of all signs of people, except for faint routes. Natural conditions and process will largely be undisturbed by people.

The **Primitive Zone** (687 acres in the project area) includes backcountry trails and popular hiking routes throughout the park. The zone emphasizes a natural landscape, where visitors experience the park on unpaved trails and routes. The zone is a largely undisturbed landscape, with natural processes predominating.

The **Frontcountry Low Development Zone** (94 acres in the project area) includes the Kolob Terrace Road, trailheads, and the Lava Point helispot. Visitor experience in this zone is fairly structured, rural, and oriented around motorized sightseeing on secondary roads, camping, picnicking, and short walks. Natural conditions are unmodified in most of the zone.

The **Administrative Zone** (5 acres in the project area) includes the areas that support park management and administration. These areas are not typically used by visitors. Natural processes and landscapes can be altered in this zone to support park operations.

The ZION FMP (NPS 2005) was completed in 2005 and describes the park's fire management strategy and operational concerns. It also identifies concerns with the grass-fire cycle and subsequent alteration of natural fire regimes. The environmental assessment prepared for the FMP provides for the use of herbicide to treat non-native species, including the treatment of cheatgrass with imazapic, but it does not fully address potential impacts of aerial application.

The Dakota Hill Complex Fire Burned Area Rehabilitation (BAR) Plan (NPS 2007) was completed in August 2007 immediately following containment of the Dakota Hill Complex. This plan prescribes rehabilitation recommendations for all lands burned within the fire perimeters and downstream impact areas. The primary objectives of the Dakota Hill Complex Fire BAR Plan are to repair or improve lands unlikely to recover naturally from wildland fire; restore or establish healthy, stable ecosystems; and repair or replace minor operating facilities damaged by fire.

The Kolob Fire BAR Plan (NPS 2006a) was completed in July 2006 immediately following containment of the Kolob fire. This plan prescribes rehabilitation recommendations for all lands burned within the fire

perimeter and downstream impact areas. The primary objectives of the Kolob Fire BAR Plan are to repair or improve lands unlikely to recover naturally from wildland fire; restore or establish healthy, stable ecosystems; and repair or replace minor operating facilities damaged by fire.

In response to the Kolob BAR plan recommendations an EA was prepared in 2006. The EA analyzed the impacts of aerial application of the herbicide imazapic on the majority of the area burned in the Kolob fire. The Finding of No Significant Impact was signed in October 2006 and work began on the project soon after. The 2006 EA provided for additional treatments, but only with those herbicides and concentrations analyzed in that EA. The treatments proposed in this EA include herbicides and concentrations not analyzed in 2006, so those treatments are part of the analysis for this EA.

Laws, Policies, and Authorities

The following regulations and guidance documents relate directly to the completion of this EA.

National Environmental Policy Act (NEPA) – The purpose of NEPA is to encourage productive and enjoyable harmony between humans and the environment; to promote efforts that would prevent or eliminate damage to the environment and stimulate the health and welfare of mankind; and to enrich the understanding of the ecological systems and natural resources important to the nation. NEPA requirements are satisfied by successful completion of an environmental assessment or environmental impact statement, in addition to a decision document.

Director's Order-12 (DO-12) – Conservation Planning, Environmental Impact Analysis, and Decision Making. DO-12 outlines the NPS guidelines for implementing NEPA according to NPS regulations. DO-12 meets all Council on Environmental Quality (CEQ) regulations for implementing NEPA.

NPS Organic Act 1916 – Congress directed the U.S. Department of the Interior and the NPS to manage units "to conserve the scenery and the natural and historic objects and the wild life therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations." (16 United States Code (USC) § 1) Congress reiterated this mandate in the Redwood National Park Expansion Act of 1978 by stating that the NPS must conduct its actions in a manner that will ensure no "derogation of the values and purposes for which these various areas have been established, except as may have been or shall be directly and specifically provided by Congress." (16 USC § 1 a-1)

Director's Order-18 (DO-18) – NPS guidance for Wildland Fire Management (NPS 2002b).

Review and Update of the 1995 Federal Wildland Fire Management Policy 2001 – provides guidance and updates for federal fire managers (USDI 2001).

In addition to the regulations and orders listed above, other regulations and policies guide the assessment of impacts. These are listed below:

- **NPS Management Policies 2006** – defines how the NPS will meet its park management responsibilities under the 1916 NPS Organic Act (NPS 2006b).
- **Utah Water Quality Regulations** – conserves waters of the state to protect, maintain, and improve water quality.
- **Wild and Scenic Rivers Act** – provides for designation and protection of wild, scenic, and recreational rivers.
- **Executive Order 11990** – provides for the protection of wetlands.

- **Clean Water Act** – provides for the protection of waters of the United States.
- **Endangered Species Act (ESA)/Section 7** – provides for the listing and protection of endangered and threatened species and their critical habitat; requires consultation under Section 7 if any listed species may be adversely affected.
- **Wilderness Act of 1964** –states that wilderness areas shall be administered for the use and enjoyment of all people in a manner that will leave them unimpaired for future use and enjoyment as wilderness. Ninety percent of Zion was proposed to Congress as wilderness in 1974.
- **Director's Order-41** – states that proposed wilderness areas are to be managed to preserve their wilderness character and values.
- **National Historic Preservation Act (NHPA)/Section 106** – provides for the identification and protection of historic sites and structures; requires consultation under Section 106 with the Utah State Historic Preservation Officer (SHPO).

Scoping

Scoping is an early and open process to determine the extent of environmental issues and alternatives to be addresses in an EA. ZION conducted both internal scoping with appropriate NPS staff and external scoping with the public and interested and affected groups, governments, and agencies.

Internal scoping, which included an interdisciplinary team of park staff, identified the purpose and need, identified potential actions to address the need, identified likely issues and impact topics, and identified the relationship of the proposed action to other park planning efforts.

A scoping letter was prepared and mailed to public, federal and state agencies and interested groups on August 9, 2007 (Refer to Appendix A). American Indian tribes traditionally associated with lands in ZION were also apprised of the proposed action on August 9, 2007. The scoping letter included a brief description of the proposed action and described opportunities for public participation. Scoping information was also posted on the park web site and the NPS Planning, Environment and Public Comment (PEPC) web site (http://parkplanning.nps.gov). A press release was issued by the park and published in local newspapers in August 2007.

Comments were solicited during external scoping until August 23, 2007. The park received three scoping comment letters. Two letters expressed concerns about the effects of herbicides on drinking water. This issue is addressed in this document as part of the proposed action and mitigation. The third letter did not identify any issues or concerns.

Impact Topics Analyzed in Detail

Issues and concerns related to the proposed action were identified by the park interdisciplinary team, as well as input from other federal, state, and local agencies. After public scoping, any issues or concerns identified were refined into specific impact topics to facilitate the analysis of environmental consequences, which allows for a standardized comparison between alternatives based on the most relevant information. Impact topics are the resources of concern that could be affected by the range of alternatives. Specific impact topics were developed to ensure that alternatives were compared on the basis of the most relevant topics. The following impact topics were identified on the basis of federal laws, regulations, orders, NPS *2006 Management Policies*, and both internal and external scoping.

Vegetation

- Invasive plants other than cheatgrass also occur in the project area that could be affected if no action is taken or if the proposed treatment is implemented.

- Native plants occur within the project area that could be affected if no action is taken or if the proposed treatment is implemented.
- The grass-fire cycle would likely lead to an increase in fire frequency, fire size, and fire intensity if no action is taken.
- Type conversion from native vegetation communities to exotic grasslands could occur if no action is taken.
- Loss of habitat for many native plants could occur if no action is taken.
- If treatment occurs, it will be essential to use adaptive management and monitor the results to determine actual effectiveness, learn from the treatment and examine if any unanticipated effects occur.

Threatened, Endangered, and Sensitive Plant Species

- State listed and sensitive plant species occur in or near the Dakota Hill Complex and Kolob Fires project area that could be affected if no action is taken or if the proposed treatment is implemented.

Wildlife

- Bioaccumulation of toxins derived from the herbicide could be a concern.
- Loss of habitat for native animals could occur if no action is taken.

Threatened, Endangered, and Sensitive Animal Species

- The project area includes critical habitat for the Mexican spotted owl and this federally listed species could be affected if no action is taken or if the proposed treatment is implemented.
- California condor could be disturbed by the proposed helicopter use if they are in the area.
- Sensitive fish species occur downstream of the project area and could be affected if no action is taken or if the proposed treatment is implemented.
- Bioaccumulation of toxins derived from the herbicide could be a concern.

Soils

- Potential herbicide mobilization within the soil could have unintended consequences.

Water Resources (Watershed and Streamflow, Water Quality, Sediment Yield, Wetlands)

- Water corridors and riparian zones could be affected if no action is taken or if the proposed treatment is implemented.
- Sediment yield could be affected if no action is taken or if the proposed treatment is implemented.
- Herbicide drift and/or herbicide mobilization within ground or surface water could have unintended consequences.
- Effects of herbicides on drinking water sources.

Natural Soundscapes

- Noise would be generated by the helicopter during treatment, including the potential for overflights on the Kolob Terrace Road, the Horse Pasture Plateau, and Dakota Hill area.

Wilderness

- Large-scale herbicide applications in a national park and in a wilderness area require careful consideration to determine appropriateness and consistency with management policies.
- Wilderness values and/or character could be affected if no action is taken or if the proposed treatment is implemented.

Public Health and Safety

- Visitor/public safety would need to be secured during the proposed treatment.
- Neighbors and lands bordering the park should be consulted prior to treatment.
- Communication with local communities is needed whether or not treatment is undertaken.
- Aviation safety will need to be planned if treatment is undertaken.
- Interagency coordination is needed to fairly consider potential impacts if no action is taken or if the proposed treatment is implemented.
- Increased risk of wildland fire is no action is taken.

Visitor Experience

- Visitor experience would be affected short-term by the necessary public use closure during treatment and could also be affected long-term if no action is taken or if the proposed treatment is implemented.

Impact Topics Dismissed from Further Consideration

The following resources would not be affected by either alternative, or do not exist in the area. They were eliminated from further analysis for the reasons stated below and will not be discussed further.

Air Quality

The air quality in ZION is protected under the Clean Air Act as a Class I airshed. However, any deterioration in air quality as a result of the proposed action would occur only during herbicide application and thus would be of very short duration and limited to localized areas. There is essentially no potential for measurable impacts to air quality as a result of this project, so this impact topic was dismissed from further consideration.

Archeological Resources

The BAR Plans (NPS 2006a, NPS 2007) state that "there were no effects to cultural resources as the result of fire suppression activities" and there were no recommendations for rehabilitation. Since the proposed action does not require any surface disturbing activities and the act of flying a helicopter over these sites would have no effect on the sites and the herbicide would not affect the sites, this impact topic was dismissed from further consideration.

Historic Structures

The BAR Plans (NPS 2006a, NPS 2007) state that "there were no effects to cultural resources as the result of fire suppression activities" and there were no recommendations for rehabilitation. Since the proposed action does not identify any actions that would affect historic structures and the act of flying a helicopter over these structures would have no effect on the structures and the herbicide would not affect the structures, this impact topic was dismissed from further consideration.

Ethnographic Resources

The NPS defines ethnographic resources as any: *...site, structure, object, landscape, or natural resource feature assigned traditional legendary, religious, subsistence, or other significance in the cultural system of a group traditionally associated with it* (Director's Order-28 – *Cultural Resource Management Guideline*). As part of scoping, letters were sent to 13 affiliated American Indian tribes asking for comments and concerns about the proposed action. The park did not receive any comments or concerns from any tribes. Also the BAR Plans (NPS 2006a, NPS 2007) state that "there were no effects to cultural resources as the result of fire suppression activities" and there were no recommendations for

rehabilitation. There are no known ethnographic resources in the area, this impact topic was dismissed from further consideration.

Cultural Landscapes
Cultural landscapes are areas associated with a historic event, activity, person, or exhibiting other cultural or aesthetic values. NPS *Management Policies 2006* section 5.3.5.2 states: *...cultural landscapes will preserve significant physical attributes, biotic systems, and uses when those uses contribute to historical significance.* The BAR Plans (NPS 2006a, NPS 2007) state that "there were no effects to cultural resources as the result of fire suppression activities" and there were no recommendations for rehabilitation. There are no known cultural landscapes in the area, so this impact topic was dismissed from further consideration.

Museum Collections
Museum collections include historic artifacts, natural specimens, and archival and manuscript material. They may be threatened by fire, vandalism, natural disasters, and careless acts. The preservation of museum collections is an ongoing process of preventative conservation, supplemented by conservation treatment, when necessary. The primary goal is preservation of artifacts in as stable condition as possible to prevent damage and minimize deterioration. The activities proposed in this plan would not affect the museum objects of ZION and there is little potential to add objects to the collections, this impact topic was dismissed from further consideration.

Economic Considerations
Economic impacts are limited to the letting of a contract to conduct the aerial herbicide application. While the contract would be substantial in dollar value, the specialized nature of the contract requirements would essentially limit the potential bidders to contractors from outside the local area, and thus the economic impact would be greatly diluted. The timing and location of the proposed treatment and the subsequent limitations to visitor use during application have been designed to avoid impacts to concessions and local businesses. Therefore, this impact topic was dismissed from further consideration.

Lightscapes
In accordance with NPS *Management Policies 2006*, the NPS strives to preserve natural ambient lightscapes, which are natural resources and values that exist in the absence of human-caused light. There are no actions proposed in this EA that would adversely affect lightscapes in the park. Therefore, this impact topic was dismissed from further consideration.

Park Administration and Facilities
No park facilities would be impacted by the proposed treatment, except for short-term occupation of the park's firing range by the helicopter and support vehicles during the application. The funding for the proposed treatment comes from BAR funding and does not affect the park's base operating budget so it would have no impact to on-going administration of the park. The management of the contract would be handled as part of assigned duties for the park's contracting officer, aviation officer, and contracting officer's representative, but would not have a noticeable impact on park administration. For these reasons, this impact topic was dismissed from further consideration.

Ecologically Critical Areas
Impacts related to proposed wild and scenic rivers are covered under the Water Quality section. No other ecologically critical areas are known in the project area. So this impact topic was dismissed from further consideration.

Floodplains
No floodplain functions would be affected by activities proposed in this EA. Functions and values related to wetlands or riparian areas located in or near floodplains are addressed under Water Resources.

Prime and Unique Farmlands
In 1980, the Council on Environmental Quality (CEQ) directed federal agencies to assess the effects of their actions on farmland soils classified as prime or unique by the United States Department of Agriculture, Natural Resources Conservation Service. Prime farmland is land that has the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops, and is also available for these uses (the land could be cropland, pastureland, rangeland, forest land, or other land, but not urban built-up land or water). Unique farmland is land other than prime farmland that is used for the production of specific high value food and fiber crops (CEQ 1980). According to Natural Resource Conservation Service maps, there are no prime or unique farmlands within the park. Therefore, this impact topic was dismissed from further consideration.

Energy Requirements/Depletable Resource Requirements and Conservation Potential
None of the alternatives would affect energy depletable resource requirements or conservation potential to the extent that detailed analysis would be required. Therefore, this impact topic was dismissed from further consideration.

Environmental Justice
Executive Order 12898 (General Actions to Address Environmental Justice in Minority Populations and Low-Income Populations) requires all agencies to incorporate environmental justice into their missions by identifying and addressing disproportionately high and adverse human health or environmental effects of their programs and policies on minorities and low-income communities. The alternatives analyzed in this document would not result in any identified effects that would be specific to any minority or low-income community. Therefore, this impact topic was dismissed from further consideration.

Indian Trust Resources
Secretarial Order 3175 requires that any anticipated impacts to Indian trust resources from a proposed project or action by the U.S. Department of the Interior agencies be explicitly addressed in environmental documents. The federal Indian trust responsibility is a legally enforceable fiduciary obligation on the part of the United States to protect tribal lands, assets, resources, and treaty rights. It represents the duty to carry out the mandates of federal law with respect to American Indian and Alaska Native tribes. There are no Indian trust resources in ZION. The lands comprising the park are not held in trust by the Secretary of the Interior for the benefit of Indians due to their status as Indian. Therefore, this impact topic was dismissed from further consideration.

ALTERNATIVES

Introduction

This section describes the alternatives analyzed in this document – the No Action and the Proposed Action as well as alternatives considered but dismissed from further consideration.

Alternative A – No Action Alternative

Under the No Action alternative, the aerial application of herbicide would not occur and the park would continue with existing management actions in the burned area. Such actions could include spot treatment with herbicide using ground-based methods, replanting native species, and other actions to alter the vegetation community. However, since no aerial application of herbicide would occur, no large-scale efforts would be made to interrupt the grass-fire cycle at this time.

Over time the no action alternative would most likely lead to perpetuation of the grass-fire cycle. It is expected that cheatgrass would quickly re-invade the burned area, with dense stands of cheatgrass most likely to be established in the next few years along roads, trails, and the western and north eastern boundary of the park. Interior areas would not be spared cheatgrass invasion, but it would likely be slower to dominate due to fewer cheatgrass seeds in the soil and more competition from native plants. Over the next few decades, cheatgrass could come to dominate much of the burned area. In response to this increasing density of cheatgrass, fire frequency, fire size, and fire intensity would continue to increase, further accelerating the loss of native plant communities. While some native plants would continue to persist, eventually most of the native plant communities and their myriad wildlife habitats would be degraded and those communities that are intolerant of frequent fire would become absent from the landscape. The result would be a permanent vegetation type conversion from native shrublands and woodlands to non-native grasslands. Such conversions have been well documented in the northern Great Basin.

The resulting invasive grasslands are both created by increasing fire frequency, fire size, and fire intensity and serve to perpetuate large and frequent fires. The continuous fuels created by the invasive grasses means that more ignition sources (i.e., lightning, cigarettes, vehicle sparks) would strike receptive fuels and start a fire. Furthermore, those continuous fuels also serve to carry the resulting fires over larger areas. Thus fires become larger and tend to spread faster as they carry through the light, flashy fuelbed formed by cured cheatgrass and its thatch layer. The increased frequency and size of fires would make it more difficult to control future fires and protect other values of concern from being burned, such as infrastructure, and natural and cultural resources.

Alternative B – Proposed Action/Preferred Alternative

The proposed action is the aerial application of herbicide on up to 3,161 acres within the 2007 Dakota Hill Complex fire and a reapplication of herbicides on up to 6,739 acres burned in the 2006 Kolob fire (Figures 2A & 2B). The purpose of the herbicide application is to inhibit cheatgrass germination and growth, which would interrupt the grass-fire cycle and thereby restore native plant communities and wildlife habitat. The operational elements of the proposal are bulleted below for easy reference and are further elaborated in the following text.

Figure 2A

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Figure 2B

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- **Treatment areas:**
    - 2007 Dakota Hill Complex – treatment areas include those that burned at the highest intensity, areas that burned in the pinyon-juniper vegetation community, ½-mile corridor within the park along the east park boundary, and trail corridors totaling 3,161 acres if sprayed in fall. If the herbicide treatment occurs in spring the spray area would be reduced to 1,880 acres to avoid sensitive plant species. Treatment is proposed to occur fall of 2007. Although treatment could occur in winter, spring or fall 2008 – subject to mitigation and environmental factors. Treatment could take up to 2 weeks to complete.
    - 2006 Kolob Fire – the re-treatment would focus on areas that have shown cheatgrass re-growth and could include up to 6,739 acres. The focus would be on areas with over 20 percent cheatgrass cover. Treatment is proposed to take place anytime from November 1, 2007 through March 15, 2008. Treatment could take up to 2 weeks to complete.
    - The following would not be sprayed in either of the treatment areas: 300-feet either side of riparian corridors and surface water; within ½-mile of Mexican spotted owl protected area centers; and in areas where control plots would be established to monitor the effectiveness of the spray treatments.
- **Herbicides:** Imazapic, trade name Plateau®, is an herbicide that has been proven effective in cheatgrass control. Glyphosate, trade name Rascal®, would be added to the imazapic if cheatgrass has begun to grow or could be used without imazapic. INDUCE®, a non-ionic surfactant, would also be added to the mixture. It is designed to quickly wet leaf and stem surfaces and to help spread a more uniform spray deposit over those surfaces.
- **Application method:** A helicopter that is specially equipped for herbicide application and operated by a pilot that is qualified for herbicide application would be used for the application. All applicators would carry required credentials for the State of Utah and the Department of the Interior. The helicopter application equipment and flight patterns are designed to minimize spray drift.
- **Application rate:** For imazapic a maximum rate of 12 ounces per acre would be used throughout the treatment area, with the exception of the no-spray areas. Glyphosate would be sprayed at a rate of no more than 16 ounces per acre. The recommended rate for INDUCE® would be 6 ounces per acre.
- **Helicopter support area:** The Lava Point helispot would be used as the staging area for the Dakota Hill Complex treatment areas (East and West). The Coalpits helibase would be used as the staging area for the Kolob fire treatments. The Lava Point helispot is inside the park in a sagebrush meadow near the Lava Point. The Coalpits helibase is inside the park, with easy access to Highway 9 for fuel and water support. These two staging areas would serve as the base of operations where the herbicide would be mixed, and the helicopters would be loaded, fueled, and secured when not in use.
    - After completion of the aerial spray, the Lava Point helispot would be rehabilitated by: raking out all visible soil disturbance; rake in seed collected from the immediate area; scatter locally collected duff over seed; and monitor for non-native plant infestations for 3-years. If non-native plants are found they would be pulled, bagged, and disposed of in an appropriate receptacle. Certain non-native plants would be treated with the appropriate herbicide using hand applications according to NPS and manufacturers specifications. The helispot has been surveyed for cultural resources and none were found.
- **Timing of application:** Ideally the treatment would occur before cheatgrass greens up in late October or early November, but any date after October 15, 2007 would be considered based on weather condition and the stage of growth of plants. Although, application could occur in winter of 2007/2008, spring 2008 or fall 2008 – subject to mitigation and other environmental factors.

- **Duration of treatment:** The treatment is expected to take approximately 2 weeks in each project area (Dakota & Kolob), depending on weather conditions that may affect actual hours of flight time per day.
- **Monitoring:** The results of the treatment would be scientifically monitored by researchers at Northern Arizona University and the U.S. Geological Survey to determine response of both cheatgrass and native plants in both treated and untreated areas.
- **Frequency of treatment:** For the Dakota Hill Complex, the area would be treated once initially, with the potential for follow-up treatments in subsequent years depending on what the monitoring results indicate would be most effective in restoring native plant communities. Monitoring results have shown that re-treatment for the Kolob area is appropriate this year.

Fall aerial herbicide application of imazapic/glyphosate is the best chance the park has of slowing an increase of cheatgrass in the area burned by the Dakota Hill Complex fires. As most of the burned areas had at least trace amounts of cheatgrass before the fire, it is expected with the increase nutrients and bare ground that cheatgrass would come to dominate much of the area post fire. There are native plant species in the burned area that can be expected to recover and flourish if the competition of cheatgrass can be suppressed.

Results of a study released in 2002 by BASF and Synergy Resource Solutions Inc. show that fire intensity can be significantly reduced in cheatgrass-infested areas treated by imazapic (Kury et al. 2002). The study found that the height of flames in treated areas can be reduced by as much as 88 percent and the rate at which the fire spreads can be lowered by as much as 95 percent, compared to untreated areas.

Research initiated by park staff, U.S. Geological Survey scientist Matt Brooks and Lake Mead Restoration Biologist, Curt Deuser with funding from Joint Fire Science examined the effects of fire, seed and imazapic (Louie et al. 2005). The treatments were initiated in the fall of 2005. Preliminary results show that fire followed by a fall season imazapic application was effective in reducing cheatgrass and allowing seed naturally found in the soil and seeded native perennials to occupy the site.

Imazapic is non-restricted use herbicide that attacks a specific enzyme found only in plants to control growth (BASF 2004, BASF 2006). Imazapic is not mutagenic or teratatogenic and would not be expected to have any adverse effect on big game and non-game species when used as labeled (BASF 2004, BASF 2006). It is considered to be nontoxic to mammals, birds, fish, and aquatic invertebrates (BASF 2006, BASF 2005). If ingested by mammals, imazapic is rapidly excreted in the urine and feces and does not bioaccumulate in animals. In addition to the acute toxicity and irritation studies conducted with imazapic show this product to be a nontoxic and nonirritating. The potential exposure to wildlife following a labeled application of imazapic would not be expected to have any adverse effects. Imazapic is nontoxic to fish and aquatic vertebrates with a 96 hour LD_{50} (lethal dose for 50 percent of animals tested) value greater than 100 milligrams per liter (mg/l) (comparable to the toxicity of caffeine).

Glyphosate is a post-emergent broad-spectrum systemic herbicide that has no soil residual activity (Agriliance 2005). It is applied to foliage and is absorbed by leaves and drawn into root tissues. Glyphosate, N-(phosphonomethyl) glycine, is the herbicides active ingredient in the form of its isopropylamine salt, with no additional surfactant. Glyphosate does not appear to be mutagenic (Weed Science Society of America 1994), teratogenic (USEPA 1992), or carcinogenic (USEPA 1992). Glyphosate binds tightly to soil particles and is rapidly degraded by soil microbes, minimizing the opportunity for off-site contamination from soil movement. Acute and chronic toxicity to mammals is very low (USEPA 1992, Agriliance 2005). INDUCE® is a non-ionic surfactant that would also be added to the mixture. It is designed to quickly wet leaf and stem surfaces and to help spread a more uniform spray deposit over those surfaces. INDUCE® may cause gastrointestinal irritation if ingested in large quantities. It is also considered a moderate skin and eye irritant (HHC 2005).

The mobility of imazapic in soil is limited (BASF 2006) and glyphosate has no mobility in the soil (Agriliance 2005). Soil binding is a complex function of soil pH, texture and organic matter content. The binding of imazapic to soil has been observed to increase with time, while binding of glyphosate is very rapid. Imazapic and glyphosate have been show to have little lateral movement in the soil. The major route of imazapic and glyphosate loss from the soil is through microbial degradation. Glyphosate generally biodegrades within 21 days and imazapic can remain viable in the soil for up to three years. From a total of nine soil dissipation studies conducted with imazapic, no residues were found below the 18-24 inch soil layer. After an application of imazapic, there is little potential for movement off the treated area and the same is true for glyphosate due to the chemical's tight binding nature to soil particles. Imazapic and glyphosate are not volatile and bind moderately to most soil types once applied. Physical movement of the treated soil would be most common way for significant quantities of imazapic or glyphosate to move outside the treatment area.

Before any spraying begins, no-spray control plots would be established as part of the effectiveness monitoring protocol. Exact size and configuration of the control plots have not yet been determined, but would be scientifically valid with consideration of vegetation type, soil, burn severity, slope, and other environmental factors. The locations of these no-spray areas, both the stream corridors as well as the control plots, would be loaded into the helicopters computer system and the pilot would be able to navigate to avoid those areas during application. In addition, there are obvious visible changes in topography and vegetation along stream corridors that the applicator can use as a guide.

During treatment, all aspects of the operation would be managed in compliance with all state laws and the chemical label requirements, including as worker and environmental safety precautions for chemical storage, mixing, and loading. The actual application rate would be measured and calibrated as needed to assure that the appropriate amount of chemical is applied per unit area of ground. The NPS would provide a certified Contracting Officers Technical Representative (COTR) to oversee the spray operation.

During treatment, the project areas would be closed to all users. This would include periodic closures of the Kolob Terrace Road and overlooks for short periods of time when the helicopter is operating in that corridor. These closures would also be implemented for the West Rim Trail corridor. Closures would be announced through normal channels, including press releases to local media outlets and bulletin boards in the park. Additionally, roadside signs would be posted along Kolob Terrace Road and in Virgin to announce the closures. Within the project area no permits for any backcountry use, including the Subway route and the West Rim Trail and associated backcountry routes, would be issued during the treatment period. Once the chemical is dried and the helicopter has left the area, the project area would be re-opened to all users.

Mitigation Measures

Mitigation is defined in the Code of Federal Regulations (40 CFR 1508.20) as:

- Avoiding the impact altogether by not taking a certain action or parts of an action.
- Minimizing impacts by limiting the degree or magnitude of the action and its implementation.
- Rectifying the impact by repairing, rehabilitating, or restoring the affected environment.
- Reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action.
- Compensating for the impact by replacing or providing substitute resources or environments.

Mitigation Measures for Alternative A – No Action Alternative

Vegetation

- Spot treat as feasible to reduce cheatgrass in very small targeted areas using ground based herbicide application methods.

Threatened, Endangered, and Sensitive Plant Species

- Spot treat as feasible to reduce cheatgrass in very small targeted areas near sensitive plant populations using ground based herbicide application methods or mechanical controls.

Natural Soundscapes

- Use non-motorized fire suppression resources and tools to the extent feasible during fire suppression.
- Continue ambient sound monitoring in and near the project area.

Wilderness

- Use minimum impact suppression tactics (MIST) as feasible during future fire events.

Public Health and Safety

- Enact temporary public use closures as needed to protect people from fires, fire suppression activities, and smoke during fire events.

Visitor Use and Experience

- Provide educational information to help the visiting public understand the grass-fire cycle and the need for public use restrictions during fire events or during periods of extreme fire danger.
- Enact campfire and smoking restrictions during periods of high fire danger to reduce possible ignition sources.

Mitigation Measures for Alternative B – Proposed Action/Preferred Alternative

General

- A pre-project meeting and orientation would be conducted with the herbicide applicator prior to beginning field application including:
    - An aerial reconnaissance of area with pilot/applicator to ensure that s/he is familiar with topography and vegetation indicators of no-spray areas.
    - Test application with observers to determine the extent of drift. This information would be used to modify buffers, or change application parameters (such as droplet size, or air speed) as needed to protect water resources and other areas that should not be sprayed.
    - Determine application patterns (grid vs. parallel to slopes and streams) best suited to avoiding no-spray areas.
    - An orientation to hazards to aircraft in the area.

Vegetation

- Use an application rate for imazapic of up to 12 ounces per acre to maximize control of cheatgrass while minimizing non-target impacts to native species. Additionally use an application rate for glyphosate of up to 16 ounces per acre after cheatgrass has emerged to kill cheatgrass while minimizing impacts to native plants.
- Use a fall application before green up or add glyphosate to the mix after green up to maximize control of cheatgrass while minimizing non-target impacts to native species.
- Protect riparian plants from herbicide injury by designation of no-spray areas.

- Establish control plots to monitor the effectiveness of the aerial herbicide treatment, and take follow-up action as appropriate based on lessons learned. Share findings with others.
- Conduct spot-treatments using ground-based herbicide application methods around roadsides and other areas to improve effectiveness of the aerial treatment.

Threatened, Endangered, and Sensitive Plant Species

- Monitor response of sensitive plant species in the project area.
- If spraying occurs in the spring all sensitive plant populations would be avoided.

Wildlife

- Protect riparian habitats from herbicide injury by designation of no-spray areas.
- Monitor the effectiveness of the aerial herbicide treatment using control plots, and take follow-up action as appropriate based on lessons learned. Share findings with others.

Threatened, Endangered, and Sensitive Animal Species

- Continue monitoring of Mexican spotted owls and peregrine falcons in the project areas.
- No-spray area within ½-mile of Mexican spotted owl protected area centers.
- Critical nesting and breeding times would be avoided (March 1 – August 31).
- Provide a treatment summary to the Utah Division of Wildlife Resources so that they can consider this treatment in their monitoring program for the flannelmouth sucker and the Virgin spinedace.

Natural Soundscapes

- Continue ambient sound monitoring in and near the project area.

Public Health and Safety

- Enact temporary public use closures during herbicide application treatment to protect people from overhead hazards and herbicide exposure.
- Restrict public access to the Coalpits helibase and Lava Point helispot while they are being used; which could include closing the road to the Lava Point lookout for up to 2-weeks.
- Follow standard aviation safety practices, such as flight following, air to ground communication, and identification of aviation hazards.
- Follow all herbicide label requirements and material safety data sheet recommendations for safe storage, handling, and application.
- Only federally registered herbicides would be used. Herbicides would be applied as per label instructions and restrictions.
- The intake operation of water for mixing would be arranged so that an air gap or reservoir would be placed between the live water intake and the mixing tank to prevent back flow or siphoning of chemical in to the water source.
- Avoid direct application of glyphosate to any body of water. To minimize drift, application of all herbicides would be confined to periods when wind speed is less than 6 miles per hours. To further limit the potential for damaging stream habitats supporting a fisheries, application equipment and calibrations must be selected to deliver sprays which minimized atomized drift in situations where herbicide would be expected directly contact surface waters. No application of herbicide may occur in drainages and valley floors when rain showers are imminent or likely within 12 hours.

Visitor Use and Experience

- Provide educational information to help the visiting public understand why the temporary public use closure is in effect during herbicide application. Provide information on alternative recreational opportunities in the park.
- For the Kolob treatment, road closure would be minimized as much as possible and would last up to 30 minutes at a time.
- For the Kolob treatment, the aerial spray would be planned to avoid impacts to hunters on nearby non-park lands.

Environmentally Preferred Alternative

As stated in Section 2.7.D of DO-12 and Handbook (NPS 2001a), the environmentally preferred alternative is the alternative that will promote the national environmental policy expressed in the NEPA (Sec. 101(b)). This includes alternatives that:

- Fulfill the responsibilities of each generation as trustee of the environment for succeeding generations.
- Ensure for all Americans safe, healthful, productive, and esthetically and culturally pleasing surroundings.
- Attain the widest range of beneficial uses of the environment without degradation, risk of health or safety, or other undesirable and unintended consequences.
- Preserve important historic, cultural, and natural aspects of our national heritage and maintain, wherever possible, an environment that supports diversity and variety of individual choice.
- Achieve a balance between population and resource use that will permit high standards of living and a wide sharing of life's amenities.
- Enhance the quality of renewable resources and approach the maximum attainable recycling of depletable resources.

Simply put, "this means the alternative that causes the least damage to the biological and physical environment; it also means the alternative which best protects, preserves, and enhances historic, cultural, and natural resources" (Question 6a in CEQ 1981). In the NPS, the No Action Alternative may also be considered in identifying the environmentally preferred alternative.

Alternative A represents no action to interrupt the grass-fire cycle. As a result, cheatgrass would continue to invade and fires would become more frequent. Under this scenario, many native plant communities would be greatly reduced and habitat value would be degraded. This type of event would result in adverse affects to many of the park's resources and values.

The Proposed Action/Preferred Alternative, Alternative B, would use aerial application of herbicide to suppress cheatgrass emergence and invasion into the burned area, thus allowing the native plants to successfully re-establish and persist in the burned area. The re-establishment of native vegetation would then restore habitat needed to support native wildlife and perpetuate natural ecosystem processes The Preferred Alternative as compared to current management/No Action Alternative would:

- Provide an environment dominated by native plant communities functioning within their natural fire regime.
- Reduce the risk to human health and safety and other undesirable consequences of frequent wildland fire.
- Improve the safety, healthfulness, and esthetics of the surroundings.
- Provide better protection of historic, cultural, and natural resources for succeeding generations.

Therefore, Alternative B, the Proposed Action/Preferred Alternative, also would be the environmentally preferred alternative.

Alternatives Considered but Dismissed From Further Analysis

The following alternatives were identified through scoping. For the reasons stated below they will not be analyzed further in this document.

Ground-based widespread application only. Aerial application by helicopter is more accurate and precise in application rate than hand spraying. It is estimated that a helicopter can spray 50 acres per hour or about 600 acres per day (6 hours of flight time). The helicopter is recommended due to the ability to fly uneven, difficult terrain; ability to fly slower allowing for prescribed water volume, increased application and local landing and refilling ability. Under optimal conditions, a person can hand treat about 2 acres per day – taking into consideration the terrain, etc. With over 3,000 acres to be treated in the Dakota Hill burn and over 6,000 acres in Kolob burn, it would take a crew of 10 people over 450 days to complete the treatments. Such a prolonged treatment period would greatly reduce the effectiveness of the treatment and would increase impacts to resources due to the continual presence of human activity in the project area. For these reasons, it was determined that this alternative would not meet the purpose and need of the project and thus it was rejected as a viable alternative.

Spray all of Dakota Hill Complex. The Dakota Hill Complex fires burned in a mosaic fashion: 17 percent of the area within the fire perimeter was unburned, 23 percent of the area had a low soil burn severity, 48 percent of the area had a moderate soil burn severity, and 12 percent had a high soil burn severity. There are also many native species within perimeter that will re-sprout after fire and many unburned patches of native vegetation that could be damaged if sprayed. For these reasons, it was determined that an alternative to spray all of the areas burned in the fire would not meet the purpose and need of the project and thus it was rejected as a viable alternative.

Seeding – with or without herbicide treatments. We considered an alternative where only seed would be spread across the burned area and no herbicide would be applied to control cheatgrass. We also considered an alternative where the area would be sprayed with herbicide and then would be seeded.

Where cheatgrass is abundant or likely to become abundant, native plant seeds often fail to germinate or establish, and seeding alone does not necessarily decrease invasive species cover or may even reduce native perennial plant cover (Brooks 2005). Similarly, cheatgrass control is only effective when combined with treatments that establish perennial species (Harris and Goebel 1976, Klemmedson and Smith 1964, Mosley et al. 1999); or, in areas where there already is a significant component of native perennial plants present, chemicals can control cheatgrass (Mosley et al. 1999) and allow the native plants to grow. The plant composition of the burned area was carefully analyzed.

As much of the area burned have plants that are known to recover from fire either by sprouting or germination of seed, the park favors allowing the natural re-establishment of native plant communities. Furthermore, widespread seeding is very difficult due to the unavailability of large amounts of native seeds and that seed introduced from elsewhere, even if native species, may not reflect the genetic makeup of the plants found in the local area.

With the potential for seed failure due to cheatgrass competition, the infeasibility of finding adequate amounts of seed, and the potential for contamination of local genetics of native plant species, this alternative would most likely be unsuccessful in restoring native plant communities at a landscape level. For these reasons it was determined that seeding, with or without the herbicide spray, would not meet the purpose and need of the project and thus was rejected as a viable alternative.

Table 1: Comparison of the Achievement of Purpose and Need by Alternative		
Purpose and Need	**Alternative A: No Action**	**Alternative B: Proposed Action/Preferred Alternative**
Contribute to the restoration of natural fire regimes and ecosystem processes.	Does not meet the purpose and need, because without treatment cheatgrass would become dominant which would increase the frequency, duration, and severity of fire. This would decrease native plant cover and wildlife habitat and interrupts natural processes.	Meets the purpose and need by actively reducing cheatgrass cover which interrupts the grass-fire cycle which allows native plant communities to regenerate and persist. These native plant communities provide habitat for wildlife and contribute to functioning ecosystems.
Interrupt the grass-fire cycle caused by cheatgrass.	Does not meet the purpose and need, because without treatment cheatgrass would become dominant which would increase the frequency, duration, and severity of fire – perpetuating the grass-fire cycle.	Meets the purpose and need by actively reducing cheatgrass cover which interrupts the grass-fire cycle which allows native plant communities to regenerate and persist. In these healthy plant communities natural fire regimes can be maintained.

Table 2: Comparative Summary of Impacts		
Impact Topic	**Alternative A – No Action**	**Alternative B – Proposed Action/Preferred Alternative**
Vegetation	Implementation of the no action alternative would result in no short-term impacts to vegetation, but would result in long-term, moderate negative impacts to vegetation.	The proposed action would result in short-term, minor negative impacts to some native plants due to herbicide exposure and long-term, moderate positive impacts due to perpetuation of native shrublands and woodlands.
Threatened, Endangered, and Sensitive Plant Species	Implementation of the no action alternative would result in no short-term impacts to threatened, endangered, and sensitive plant species, but would result in long-term, moderate negative impacts to sensitive plants. Shivwits milkvetch – no effect to plants or populations and would not result in reduction or adverse modification for Shivwits milkvetch critical habitat.	The proposed action could result in short-term, minor negative impacts to some state listed plants due to herbicide exposure. Long-term, moderate positive impacts would be seen due to perpetuation of native plant communities. Shivwits milkvetch – no effect to plants or populations and would not result in reduction or adverse modification for Shivwits milkvetch critical habitat.
Wildlife	Implementation of the no action alternative would result in no short-term impacts to wildlife, but would result in long-term, moderate negative impacts to wildlife.	The proposed action would result in short-term, minor negative impacts to some animals due to herbicide exposure and response to the helicopter. There would be long-term, moderate positive impacts due to perpetuation of native wildlife habitat.
Threatened, Endangered, and Sensitive Animal Species	Implementation of the no action alternative would result in no short-term impacts to threatened, endangered, and sensitive animal species, but would result in long-term, minor to moderate negative. Mexican spotted owl – may affect, not likely to adversely affect and would not result in reduction or adverse modification critical habitat. California condor – may affect, not likely to adversely affect. Virgin River chub & woundfin – no effect.	The proposed action would result in short-term, negligible negative impacts to some threatened, endangered, and sensitive birds due to the noise generated by the helicopter. There would be no short-term impacts on fish species. There would be minor positive impacts to threatened, endangered, and sensitive animal species due to perpetuation of suitable habitat. Mexican spotted owl – may affect, not likely to adversely affect and would not result in reduction or adverse modification critical habitat. California condor – m**ay** affect, not likely to adversely affect. Virgin River chub & woundfin – no effect.
Soils	Implementation of the no action alternative would result in no short-term impacts to soils, but would result in long-term, minor negative impacts to soils.	The proposed action would result in short-term, minor negative impacts to soil and long-term, moderate positive impacts.

Table 2: Comparative Summary of Impacts		
Impact Topic	**Alternative A – No Action**	**Alternative B – Proposed Action/Preferred Alternative**
Water Resources	Implementation of the no action alternative would result in no short-term impacts to water resources, but would result in long-term, minor to moderate negative impacts to water resources.	The proposed action would result in short-term, negligible to minor negative impacts to water resources, and long-term, moderate positive impacts to water resources.
Natural Soundscapes	Implementation of the no action alternative would result in no short-term impacts to soundscapes, but would result in long-term, negligible negative impacts to soundscapes.	The proposed action would result in short-term, negligible negative impacts to soundscapes in frontcountry settings during daylight hours and short-term, moderate negative impacts to soundscapes in primitive or pristine settings during daylight hours as a result of helicopter noise. There would be long-term minor positive impacts to soundscapes.
Wilderness	Implementation of the no action alternative would result in no short-term impacts to wilderness, but would result in long-term, moderate negative impacts to wilderness due to loss of naturalness.	The proposed action would result in short-term, moderate negative impacts to wilderness due to the introduction of herbicide and the intrusion of the helicopter in wilderness. There would be long-term, moderate positive impacts to wilderness.
Public Health & Safety	Implementation of the no action alternative would result in no short-term impacts to public health and safety, but would result in long-term, minor negative impacts to public health and safety.	All short-term, negative impacts to public health and safety can be mitigated. There would be long-term, minor positive impacts to public health and safety.
Visitor Use & Experience	Implementation of the no action alternative would result in no short-term impacts to visitor use and experience, but would result in long-term, minor negative impacts to visitor use and experience.	There would be short-term, minor negative impacts to visitor use due to public use closures and long-term, minor positive impacts to visitor experience.

AFFECTED ENVIRONMENT & ENVIRONMENTAL CONSEQUENCES

Methodology for Assessing Impacts

In order to analyze the environmental consequences of the alternatives proposed in this document, three factors must be examined for each resource: type of impact, duration of impact, and intensity of impact. After the environmental consequences of the alternatives are examined by separate topic, the impact of implementing the alternative is considered along with the impacts of other relevant actions in the area.

The type of impact describes a relative measure of beneficial or adverse effects on biological or physical systems, cultural resources, or the social environment. Because impacts could have short-term, adverse impacts while having long-term, beneficial impacts, it is important to look at the duration of the effect of an impact.

However, examining only the type and duration of an impact is not enough because an impact could cover a large area or a large portion of a population, or could be highly noticeable or even irreversible. Impacts can vary in intensity, from small and imperceptible to large and substantial. Measures of intensity consider whether an impact would be negligible, minor, moderate, or major. These measures are used to describe both beneficial and adverse impacts.

Cumulative Impacts

Cumulative impacts are also considered in this analysis. A cumulative impact is described in the CEQ regulations (1508.7) as "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions." Cumulative impacts can result from individually minor but collectively major actions taking place over a period of time.

Cumulative impacts of each alternative were addressed by considering the effects of the alternative, combined with the effects of the following past, present, and reasonably foreseeable future actions that were identified in and around the project areas. The following are considered cumulative actions to the proposed action:

Yellow Star Thistle Monitoring and Control. Over the next 3 years, park staff will monitor the burned areas, trails, and transportation corridors within the park associated with the Dakota Hill Complex fire for infestations of yellow star thistle, a winter annual. If plants are found they will be hand pulled and bagged. If large infestations are found, which is not likely, hand application of herbicides will be used according to NPS and herbicide label specifications. Any control will be conducted using Integrated Pest Management practices.

Sensitive Plant Monitoring and Control of Non-Native Species. Over the next 3 years known sensitive plant populations within the Dakota Hill Complex will be monitored to determine the effects of the fire and any treatments associated with the fire on these species. Their abundance and condition will be documented. Any non-native plant species in the vicinity of the sensitive plants will either be hand-pulled and bagged or if appropriate hand sprayed with an herbicide according to NPS and herbicide label specifications. Any control will be conducted using Integrated Pest Management practices. The species that will be monitored include: Zion daisy (*Erigeron sionis*), Religious daisy (*Erigeron religiosus*), Zion penstemon (*Penstemon humilis* var. *obtusifolius*), Clark's lomatium (*Lomatium graveolens var. clarkii),* Charleston's violet *(Viola charlestonensis),* Panguitch buckwheat *(Eriogonum panguicense),* Higgin's penstomen *(Penstemon leonardii var. higginsii),* Zion draba (*Draba asperella*), Cannan daisy (*Erigeron canaani*), Jone's goldenaster (*Heterotheca jonesii*), and Foster's columbine (*Aquilegia formosa var. fosteri*).

East Boundary Fence Replacement. Almost 4-miles of fence along the east boundary of the park was damaged in the Dakota Hill Fire. The fence must be replaced to keep trespass livestock and recreational ATV users out of this area of the park. Much of the area along the fence was densely vegetated with oak brush, pinyon and juniper, and ponderosa pine prior to the fire. During the fire, extremely intense heat built up along the fence which resulted in much of the 36-inch woven wire being brought down. Most of the fence posts are metal and would not need replacement. Nearly all the woven wire observed is structurally sound and could be reattached to the T-posts. The double strand barbwire that was above the woven wire had been cut in several places prior to the fire and would need to be replaced in entirety. This project will be completed before the proposed aerial spray.

Stabilization of Cabin Spring, Trail Reconstruction and Clearing, and Hazard Tree Removal. The Dakota Hill West fire removed most of the vegetative cover above Cabin Spring exposing the soil and increasing the potential for sediment movement during runoff events. Sediment would most likely fill the spring denying access to a critical water source for visitors and wildlife. Fire resulted in damage to the trail, hazard trees along trails and campsites. Before the proposed aerial spray begins, crews will stabilize the area above the spring with jute fabric, place logs around the spring to divert water, replace waterbars on the trail, clear hazard trees, and reinstall direction and campsite signs.

Rehabilitation of the Lower West Rim Trail. Before the Dakota fire started, work had begun on the lower West Rim Trail from Little Siberia to the Virgin River foot bridge. Once the fire started work on the trail stopped. The trail work could resume at anytime time. The first phase of the work consisted of removing old trail cement and flying it out with a helicopter. The second phase of trail work will occur below the mouth of Refrigerator Canyon. This will include removing broken, excess material from the trail (old asphalt and cement) and resurfacing the trail with cement. The old excess material will be taken out by hand. The new cement will be poured using helicopter support. During helicopter operations and while the cement dries the trail will be closed to visitors.

Pine Valley Peak Prescribed Burn. The park has approved a 1,600 acre broadcast burn in the Pine Valley Peak area of the park – in the vicinity of the Wildcat Canyon Trail. The burn could happen anytime after February 1, 2007, subject to identified mitigation and burn prescription. The fire would be started with drip torches, no helicopters would be used. This action will reduce hazardous fuels, reintroduce fire into the area, and provide boundary protection. Specific goals associated with this second entry burn are to continue to apply fire to the landscape thus maintaining the natural role fire plays in this ecosystem and maintain boundary protection by reducing excess hazardous fuels.

Impairment Analysis Method

The NPS *Management Policies* (NPS 2006b) requires analysis of potential effects to determine whether or not actions would impair park resources or values.

The fundamental purpose of the National Park system, established by the Organic Act and reaffirmed by the General Authorities Act, as amended, begins with a mandate to conserve park resources and values. NPS managers must always seek ways to avoid, or to minimize to the greatest degree practicable, actions that would adversely affect park resources and values.

These laws give the NPS the management discretion to allow impacts to park resources and values when necessary and appropriate to fulfill the purposes of the park, as long as the impact does not constitute impairment of the affected resources and values. Although Congress has given the NPS the management discretion to allow certain impacts within parks, that discretion is limited by the statutory requirements that the NPS must leave park resources and values unimpaired, unless a particular law directly and specifically provides otherwise.

The prohibited impairment is an impact that, in the professional judgment of the responsible NPS manager, would harm the integrity of park resources or values, including the opportunities that otherwise would be present for the enjoyment of those resources and values. An impact to any park resource or value may constitute impairment. Impairment may result from NPS management activities, visitor activities, or activities undertaken by concessionaires, contractors, and others operating in the park. An impact would be more likely to constitute impairment to the extent that it has a major or severe adverse effect upon a resource or value whose conservation is:

- necessary to fulfill specific purposes identified in the established legislation or proclamation of the park;
- key to the natural or cultural integrity of the park or to opportunities for enjoyment of the park; or
- identified as a goal in the park's general management plan or other relevant NPS planning documents.

A determination on impairment is included in the impact analysis section for all impact topics relating to park resources and values.

Vegetation

The vegetation of ZION and the surrounding area was mapped through a project with the U.S. Bureau of Reclamation, The Nature Conservancy (Nature Serve), and the NPS (Cogan et al. 2004). This information was further refined and analyzed in the development of the park's FMP (NPS 2005) to highlight those vegetation attributes most relevant to fire. After the Dakota Hill Complex the burned area was investigated by Kara Paintner (NPS Plant and Fire Ecologist), Ken Holsinger (BLM Botantist), and members of the park staff, primarily Cheryl Decker (Vegetation Manager) and Kelly Fuhrmann (Fire Ecologist). The results of their investigation were summarized in the Dakota Hill Complex BAR Plan (NPS 2007). The site specific information presented below comes primarily from the BAR Plan.

Affected Environment

Dakota Hill Complex - 2007

The East fire burned in areas from 5,700 to 6,800 feet in elevation and the West fire burned at elevations from 6,000 to 7,300 feet. Several plant community types burned with a wide range of fire return intervals and fire adaptations (Refer to Tables 3 & 4 & Figure 3A). Vegetation at these elevations is highly variable ranging from moderately sparse and low in stature to densely vegetated moderately tall in stature shrubs, to open very tall pine and fir forests. The fire return intervals in these vegetation communities range from little to no fire adaptations to highly adapted fire prone systems that historically burned more frequently. Cheatgrass and other invasive annual bromes have established in nearly every vegetation community found within the park and on lands adjacent to the park.

Table 3: Plant Communities from the Zion FMP
Acreage, Percentage, and Fire Return Intervals within the Dakota Hill West Fire

Plant Communities	Acres	Area (percent)	Fire Return Interval (years)
Mountain Shrub	1,125	60	20-40
Ponderosa Pine	463	22	5-25
Bare Soil/Stone Formations	199	10	NA - Unburnable
Juniper-Pinyon	74	3	50-150
Slickrock	42	2	NA - Unburnable
Douglas Fir	23	1	50-80
Grass-Herbaceous Lands	19	1	25-50
Exotic Grasses	6	< 1	1-10
Wetland/Riparian	1	< 1	100+
Return Intervals from Zouhar (2003) and Campbell and others (2003)			

Table 4: Plant Communities from the Zion FMP Acreage, Percentage, and Fire Return Intervals within the Dakota Hill East Fire			
Plant Communities	**Acres**	**Area (percent)**	**Fire Return Interval (years)**
Juniper-Pinyon	1,402	37	50-150
Mountain Shrub	1,111	29	20-40
Ponderosa Pine	1,062	28	5-25
Shrublands	103	2	40-60
Bare Soil/Stone Formations	51	1	NA - Unburnable
Slickrock	33	< 1	NA - Unburnable
Grass-Herbaceous Lands	18	< 1	25-50
Douglas Fir	14	< 1	50-80
Wetland/Riparian	1	< 1	100+
Exotic Grasses	0.4	< 1	1-10
Return Intervals from Zouhar (2003) and Campbell and others (2003)			

The plateaus on which the fires burned support primarily three major vegetative communities. These vegetations communities are described below.

The pinyon-juniper community is comprised of pinyon pine (*Pinus monophylla*), one-seed juniper (*Juniperus monosperma*), sagebrush (*Artemesia filifolia* and *A. tridentata*), and rubber rabbitbrush (*Chrysothamnus nauseosa*). Interspersed within these species are pockets of grasses, mainly sand dropseed (*Sporobolus cryptandrus*), mutton grass (*Poa fendleriana*), blue grama (*Bouteloua gracilis*), needle and tread (S*tipa comata*), Indian ricegrass (*Oryzopsis hymenoides*) and the non-native cheatgrass. Cheatgrass is a concern because of its presence and potential to increase in abundance, its flammability, and its potential to dominate vegetation communities.

The mountain shrub community is comprised of Gambel oak (*Quercus gambellii*) with lesser representations of Utah serviceberry (*Amelanchier utahensis*), mountain mahogany (*Cercocarpus montanus*), sagebrush (*Artemisia tridentata* ssp. *vaseyana*), and snowberry (*Symphoricarpos oreophilus*). Interspersed within these species are pockets of grasses, mainly mutton grass, bottlebrush squirreltail (*Elymus elymoides*), needle and tread, elk sedge (*Carex geyeri*) and to a lesser degree than in the pinyon-juniper type, non-native cheatgrass. This community represents the greatest amount of acreage burned within Dakota Hill Complex comprising 60 percent of the West fire and 29 percent of the East fire. The re-sprouting nature of the most abundant shrubs within this community would not be inhibited by cheatgrass presence or dominance however; the presence and potential dominance of the interspaces of this community by cheatgrass would accelerate the fire return interval and potentially out-compete the native herbaceous components of the community.

The ponderosa pine (*Pinus ponderosa*) vegetation communities affected by the fire are distinguished by three main complexes. The first, ponderosa pine/Gambel oak complex has a prominent Gambel oak understory with lesser representations of rocky mountain juniper (*Juniperus scopulorum*), little leaf manzanita (*Acrotstaphylos patula*), and bracken fern (*Pteridium aquilinum*). The second, ponderosa pine/mixed herbaceous woodland complex has open ponderosa stands of 10-30 percent with a mix of shrubs including Gambel oak, black sage (*Artemisia nova*), and little leaf manzanita, grasses and grass like plants including Ross' sedge (*Carex rossii*), squirreltail, and Sandberg bluegrass (*Poa secunda*). The third, ponderosa pine/manzanita complex is comprised of open ponderosa pine canopies ranging between 10-30 percent with a predominantly manzanita understory with lesser representations of Utah juniper, pinyon pine, serviceberry, Gambel oak, mountain mahogany, and bitterbrush (*Purshia tridentata*).

The ponderosa pine/Gambel oak and ponderosa pine/manzanita complexes comprised much of the high severity burn areas within these communities resulting in almost total above ground biomass consumption of the understory species indicating long duration intense heat. These two complexes also sustained substantial ponderosa mortality with short duration crown runs. The high burn severity observed within the ponderosa shrub complexes did not appear to be substantially infested with cheatgrass based on field visits made to adjacent areas of unburned vegetation. The areas that experienced the greatest burn intensity within these communities would be the most susceptible to cheatgrass increase or potential type conversion. The re-sprouting nature of the shrubs within this community would not be affected by cheatgrass presence or dominance however; the presence and potential dominance of the interspaces of this community by cheatgrass would accelerate the fire return interval and potentially out-compete the native herbaceous components of the community.

The vegetation community of particular concern is the pinyon-juniper woodland. This woodland comprises 37 percent of the acreage burned in the East fire. In this vegetation community the herbaceous layer is absent or very sparse (Cogan et al. 2003). Fires in this community are thought to be infrequent because pinyon, juniper and big sagebrush are easily killed by fire and do not re-sprout (Barney and Frischknecht 1974, Everett 1987). Big sagebrush would re-establish relatively quickly (about 10-20 years) if a seed source is nearby (Barney and Frischknecht 1974, Bunting 1987). However, in the East fire over 1,000 acres of this type burned at moderate-high soil burn severity; combined with the high erosion potential and watershed response of the area would make it particularly difficult to re-vegetate.

Most of the trees and shrubs in the pinyon-juniper type regenerate from seed. Both pinyon and juniper have large seeds with short dispersal distances, except when eaten by birds. Pinyon pine is fairly susceptible to both crown scorch and cambial damage. Junipers can sustain much more crown scorch and survive. None of the woody sagebrush species in the park sprout from the roots and need a local seed source to reoccupy the site. Table 5 identifies common shrubs in the areas and there ability to re-sprout from the crown. This ability would be critical with the potential for cheatgrass invasion and shortened fire return intervals. Evidence from the northern Great Basin have shown that non-sprouting shrub species are the most easily displaced from the system by shortened fire return intervals, although with very frequent fire sometimes even the sprouting species are taken out of the system.

Table 5: Common shrubs & Their Sprouting Capability

Common Name	Scientific Name	Re-sprout?
Big Sagebrush	*Artemisia tridentata*	No
Little leaf manzanita	*Acrotstaphylos patula*	Yes
Sand sagebrush	*Artemisia filifolia*	Yes
Rabbitbrush	*Chrysothamnus spp.*	Yes
Blackbrush	*Coleogyne ramosissima*	No
Broom snakeweed	*Gutierrezia sarothrae*	Yes
Four-wing saltbush	*Atriplex canescens*	No
Mormon tea	*Ephedra nevadensis*	No
Gamble oak	*Quercus gambellii*	Yes
Shrub live oak	*Quercus turbinella*	No
Utah serviceberry	*Amelanchier utahensis*	Yes

Figure 3A

back

Over 24 percent of the plots visited during the vegetation mapping effort, within the areas burned by the Dakota fires, showed at least trace amounts of cheatgrass (Cogan et al. 2004). Field visits to both the East and West fires show the understory in unburned islands and in vegetation communities adjacent to the fires have cheatgrass with varying levels of native component.

The East fire appeared to have the greatest level of cheatgrass infestation with every interior unburned portion of the fire visited having at least low levels of cheatgrass presence. There were varying levels of cheatgrass infestation in vegetation communities directly adjacent to the fire on the Bureau of Land Management (BLM) and NPS administered sides of the fire, but cheatgrass was observed in all vegetation types encountered. These findings would indicate that the East fire had an even distribution of cheatgrass throughout the fire area prior to the burn. The infestations were likely not at levels observed in lower elevation pinyon-juniper woodlands such as those along the Kolob Terrace and Smith Mesa Road but due to the large percentage (39 percent) of high severity burn area associated with the East fire it can be expected that the level of cheatgrass would increase post-fire. Due to the rainfall events of the time period between July 24 and August 1 several warm and cool season grasses were observed sprouting on the East fire.

The East fire burned considerably cooler over a greater percentage of the area. The West fire had a high severity burn concentrated in the Telephone Canyon area and east facing slopes just above the rim of the plateau in the Gambel oak and ponderosa pine. The vegetation mapping showed an even distribution of cheatgrass throughout the areas burned. Additional survey of the West Rim Trail during the Kolob BAR field assessment showed trace amounts of cheatgrass along the western flank of the fire. Cheatgrass was only observed in the lower ¼ of Telephone Canyon on the south facing slopes in the Gambel oak communities directly adjacent to ponderosa pine which experienced stand replacement burn severity. The Burned Area Emergency Response (BAER) team assessment focused primarily on the high severity burn areas of the West fire. Unlike the East fire, cheatgrass did not appear to be as common throughout the burn area and most likely tied to the oak and ponderosa pine communities which experienced the greatest burn severity in a fire that burned the same area in 1996. The field assessment also indicated very strong native vegetation response post-fire with vigorous re-sprouting of native grasses and shrubs. Re-sprouting was notably strong in the middle portions of Telephone Canyon and above the rim to the south of Telephone Canyon.

Kolob Fire - 2006

Within the park, the Kolob Fire occurred at 3,666 to 6,900 feet in elevation and burned in the Lower Sonoran, Upper Sonoran, and Transition Zones. Vegetation in the lower to mid-elevations of the park, including the Kolob Fire burned area, is generally sparse and low in stature due to lack of moisture. Semi-arid desert species are common, such as blackbrush (*Coleogyne ramosissima*), four-wing saltbush (*Atriplex canescens*) and mesquite (*Prosopis glandulosa*). Sandy slopes upland from waterways support mostly pinyon pines (*Pinus edulis*, *P. monophylla*), juniper (*Juniperus osteosperma*), sand and sagebrush, and rubber rabbitbrush. Interspersed within these species are pockets of grasses, mainly sand dropseed, mutton grass, and the invading non-native red brome and cheatgrass.

The vegetation communities across the fire have a wide variety of fire adaptations and fire return intervals (Figure 3B & Table 6). Over three quarters of the vegetation burned in the fire was in the pinyon-juniper community. Historically this vegetation type has a highly variable fire return interval. Earlier work in the park estimated that this type has not burned in at least 160 years (West and Loope 1977). Much of the pinyon-juniper in the fire has an herbaceous understory. These herbaceous natives should naturally re-establish after fire, if they aren't out competed by cheatgrass.

The juniper and sagebrush woodland mainly occurs in the Crater Hill area with fine sandy to cindery soils. The herbaceous layer is absent or very sparse (Cogan et al. 2004). Fires in this community are

thought to be infrequent because smaller Utah juniper and big sagebrush are easily killed by fire and do not re-sprout (Barney and Frischknecht 1974, Everett 1987). Big sagebrush would re-establish relatively quickly (about 10-20 years) if a seed source is nearby (Barney and Frischknecht 1974, Bunting 1987). Additionally, Utah Juniper is relatively slow to recover following fire, and sagebrush may dominate the sites for decades (Jameson et al. 1962). If fire-return intervals are more frequent than 10 years, as expected if cheatgrass becomes dominant on these sites, then big sagebrush has difficulty recovering (Bunting 1987, Everett 1987).

Table 6: Plant Communities from the Zion FMP
Acreage, Percentage, and Fire Return Intervals within the Kolob Fire

Plant Communities	Acres	Area (percent)	Fire Return Interval (years)
Juniper-Pinyon	7,882	75	50-150
Shrublands	723	7	40-60
Bare Soil/Stone Formations	530	5	NA - Unburnable
Desert Shrublands	440	4	100+
Mountain Shrub	394	4	20-40
Grass-Herbaceous Lands	231	2	25-50
Wetland/Riparian	191	2	100+
Ponderosa Pine	67	1	5-25
Exotic Grasses	26	0	1-10
Slickrock	17	0	NA - Unburnable
Exotic Riparian	3	0	Unknown
Douglas Fir	2	0	50-80
Return Intervals from Zouhar (2003) and Campbell and others (2003)			

Most of the trees and shrubs in the juniper-big sagebrush woodland and through the rest of the pinyon-juniper vegetation community regenerate from seed. Both pinyon and juniper have large seeds with short dispersal distances, except when eaten by birds. Pinyon pine is fairly susceptible to both crown scorch and cambial damage. Junipers can sustain much more crown scorch and survive. All of the woody sagebrush species in the park are not sprouting species and need a local seed source to re-occupy the site. A few of the common shrubs and their ability to re-sprout from the crown are listed in Table 5. This ability would be critical if cheatgrass invades and the fire frequency increases. Evidence from the northern Great Basin has shown that non-sprouting shrub species are the most easily displaced from the system by shortened fire return intervals, although with very repeated frequent fire sometimes even the sprouting species are taken out of the system (Barney 1974, Bunting 1987).

The fire also burned through and around riparian areas on 193 acres. Canyons in the park are an important desert oasis, with streams, seeps, wetlands, and hanging gardens. Perennial and ephemeral streams converge into the East and North Forks of the Virgin River, hosting riparian tree species such as the Fremont cottonwood (*Populus fremontii*), Goodings willow (*Salix goodingii*), boxelder (*Acer negundo*), and velvet ash (*Fraxinus velutina*). Seepwillow (*Baccharis emoryi*) and coyote willow (*Salix exigua*) are common riparian shrubs. While wetland/riparian areas represent a small percentage of the burned area, these communities provide many important habitat functions for a number of wildlife species. In the wetland and riparian category, a small percentage of the area (2 percent) shows high burn severity. The majority of this community is either unburned (26 percent) or low burn severity (49 percent). There could be some concern for the cottonwoods in these systems due to crown scorch. A substantial threat to native plant communities within floodplains and increasingly in the uplands is the invasion and dominance of the exotic annual grasses, collectively referred to in this document as cheatgrass, that include downy brome, red brome and ripgut brome that would serve to carry fire into these riparian corridors.

Figure 3B

back

Within the burned area over 70 percent of the plots visited by the vegetation mapping effort in 2003-04 showed at least trace amounts of cheatgrass (Cogan et al. 2004). Field visits to the areas along the Kolob Terrace Road show the understory almost totally dominated by cheatgrass with very little native component. Before the fire, the area around the Kolob Terrace and Smith Mesa Road had understory vegetation that were totally dominated by cheatgrass. Examining the area just up the road, near the Subway Trailhead, there is little visible evidence of other herbaceous native plants. Areas in the Crater Hill area had cheatgrass as well. In the heavier clays soils in the area galleta grass (*Hilaria jamesii*) was already greening up from a recent rain. To the east and north of the burned area, cheatgrass occurrence was much less at about 40 percent. Additional survey of the West Rim Trail showed only trace amounts at high elevations. Within the burned area it can be expected that cheatgrass populations would increase post fire.

Impact Threshold Definitions

Negligible	No native vegetation would be affected, or some individual native plants could be affected as a result of the alternative, but there would be no effect on native species populations. The effects would be on a small scale. Non-native vegetation would not be affected.
Minor	The alternative would temporarily affect some individual native plants and would also affect a relatively minor portion of that species' population. Mitigation to offset adverse effects could be required and would be effective. Some non-native plants would be affected.
Moderate	The alternative would affect some individual native plants and would also affect a sizeable segment of the species' population over a relatively large area. Mitigation to offset adverse effects could be extensive, but would likely be successful. There would be a sizable affect on non-native plants.
Major	The alternative would have a considerable affect on native plant populations and would affect a relatively large area in and outside of the park. Mitigation measures to offset the adverse effects would be required and would be extensive; success of the mitigation measures would not be guaranteed. There would be a sizable affect on non-native plants.
Duration	Short-term – recovers in less than three years
	Long-term – requires more than three years to recover
Area of Analysis	Within and immediately adjacent to the project areas inside the park boundary

Effects of Alternative A – No Action Alternative

Under the no action alternative, no aerial herbicide application would occur. There would be no non-target effects of herbicide on the native or non-native plant species within the project area. Plants would re-sprout or germinate, grow, reproduce, and die in response to other biological and environmental factors. There would be no post-emergent or pre-emergent effect on plants within the project area. As there are no other known methods to effectively interrupt the grass-fire cycle in a wildland landscape, it is anticipated that cheatgrass could re-establish.

Short-term uncontrolled cheatgrass invasion in the burned area could result in localized displacement of native species. Such displacement occurs by two primary methods. First, the cheatgrass germinates earlier than native species and thus has a chance to occupy growing space and use soil water and nutrient resources before the native species have an opportunity to grow, thus depriving native species of the materials needed for life which reduces germination rates and recruitment success of native species (Brooks et al. 2004). Secondly, cheatgrass alters the growing environment by creating a dense thatch layer composed of the dead plant materials from previous growing seasons that covers the soil surface. This thatch layer serves to deter seed set, germination, and recruitment of some native plants, particularly annual species and biological soil crust communities. The first winter following the fire, the existing

cheatgrass seedbanks would germinate and grow vigorously in response to the increased soil water and nutrient conditions that exist as a result of the fire and the thatch would begin forming at the end of the first growing season and become thicker in subsequent years. As the cheatgrass seedbanks are most abundant along the trails in the West fire, it is expected that these areas could see a dense and fairly continuous cover of cheatgrass within one or two growing seasons. In the interior sections of the project area, cheatgrass would also germinate and grow, but would likely be more sparse and patchy the first few years after the fire due to the smaller amount of cheatgrass seed available and because the native plant populations are likely to be healthier and therefore more competitive initially. Each successive growing season would increase the continuity between interior cheatgrass patches.

Long-term, the project area is considered at risk for cheatgrass invasion (Pellent 2003). Uncontrolled cheatgrass invasion is expected to alter natural ecosystem processes (Brooks et al. 2004), particularly fire regimes. Over the next several years, it is expected that cheatgrass would become increasingly more dense and continuous throughout the burned area. Each successive growing season increases the cheatgrass seedbank in the soil and leaves an increasingly deep layer of thatch on the soil surface (Brooks et al. 2004). Within 5-10 years, it is expected that cheatgrass could form a continuous fine fuel layer across much of the burned area. As cheatgrass invasion is known to shorten fire return intervals to 3-5 years (BASF 2003a), the project area would likely experience at least one other large-scale fire event during this 5-10 year time period. This grass-fire cycle would likely continue and fires would continue to increase in frequency, size, and intensity with each fire. With each successive fire event, many native perennial plant species would be less likely to recover and re-establish either through sprouting or seed germination. Most notably, sagebrush species, blackbrush, and saltbush do not easily regenerate after fire (Table 5) and riparian species are sometimes slow to regenerate, so these species can be expected to be extirpated from the project area if fires become more frequent. Under a frequent fire scenario, the seedbanks of many native annual and perennial species would be reduced with each fire event as seeds succumb to heat mortality, diminished viability over time resulting from years of inability to germinate due to cheatgrass competition, or are removed from suitable growing locations in soil that erodes as a result of normal post-fire watershed responses. If the time between fires does not allow for sufficient seed production, the seedbank continues to deplete until there are virtually no viable seeds left to restore native plant communities. Species that are fire intolerant would be the first to be extirpated from the area and the species composition of most plant communities would be altered. As discussed in the soils section of this document, frequent large fires would likely preclude the recolonization or succession of biological soil crusts, which in turn would impact the ability of some vascular plants to re-establish on burned areas. Eventually, native woodlands and shrublands could be converted into invasive grasslands.

Cumulative Impacts. Implementation of the no action alternative would mean that aerial herbicide application would not occur and the grass-fire cycle would be perpetuated, which would reduce the effectiveness of other projects: yellow star thistle monitoring and control, sensitive plant monitoring and control of non-native species, stabilization of Cabin Spring, and the Pine Valley Peak prescribed burn. The resulting increase in wildland fires would likely result in wide-spread losses of native plant populations and degradation of native plant communities.

The no action alternative in relation to vegetation would not have any impact on other actions associated with emergency stabilization after the Dakota Hill fire including the boundary fence reconstruction, trail reconstruction and clearing, and hazard tree removal. The no action alternative does not have any relationship to or would affect the rehabilitation of the lower West Rim Trail.

Overall, impacts of no action added to the impacts of other actions affecting vegetation, would result in long-term, moderate cumulative negative impacts to native plant communities and populations.

Conclusion. Implementation of the no action alternative would result in no short-term impacts to vegetation, but would result in long-term, moderate negative impacts to vegetation due to perpetuation of the grass-fire cycle which ultimately could lead to loss of native shrubland and woodland communities and extirpation of some native plant species.

Impairment. Because there would be no major, adverse impacts to vegetation whose conservation is (1) necessary to fulfill specific purposes identified in the established legislation of Zion; (2) key to the natural or cultural integrity of the park; or (3) identified as a goal in the park's GMP or other relevant NPS planning documents, there would be no impairment to the park's vegetation resources from the implementation of Alternative A.

Effects of Alternative B – Proposed Action/Preferred Alternative

If cheatgrass has not greened up, imazapic-based herbicide would be applied during the fall season by helicopter to selected areas of the Dakota Hill Complex fires. If cheatgrass has greened up, then glyphosate based herbicide would be added to the spray mix. The most likely scenario for spraying would include both herbicides. INDUCE® is a non-ionic surfactant that would also be added to the mixture. It is designed to quickly wet leaf and stem surfaces and to help spread a more uniform spray deposit over those surfaces (HHC 2005).

The re-treatment in the area of the Kolob fire would include both imazapic and glyphosate and could occur anytime from November 1, 2007 through March 15, 2008. During this time native perennial plants are dormant and would be less likely to be affect by the glyphosate.

Imazapic is the active ingredient in a pre-emergent herbicide that controls weeds by inhibiting the plant-specific enzyme, acetohydroxyacid synthase, which is involved in the synthesis of three specific amino acids: isoleucine, leucine and valine. This inhibition disrupts protein synthesis and subsequently interferes with DNA synthesis and cell growth (BASF 2003b). Imazapic is readily absorbed through leaves, stems, and roots and is translocated rapidly throughout the plant, with accumulation in the meristematic regions which is where growth originates. Treated plants stop growing soon after spray application. Chlorosis appears first in the newest leaves, and necrosis spreads from this point. In perennial species, the herbicide is translocated into the underground storage organs which prevent re-growth (BASF 2006).

Plant response to imazapic varies by species, season, and exposure to the chemical. Generally, warm season species that germinate and grow in late spring and summer are tolerant of fall imazapic application, while cool season species that germinate and grow in winter or early spring are more commonly intolerant of fall herbicide application. Based on field trials (BASF 2004, Monaco et al. 2005) and experimental treatments within ZION (Louie et al. 2005) some native grass species that occur in the project area and are known to be tolerant of fall application of imazapic.

Glyphosate is the active ingredient in herbicides that are applied as a foliar spray to control or destroy weeds. Glyphosate moves through the plant from its contact with foliage to and into the root system. Visible effects on most annual weeds occur within 2 to 4 days. For most perennial weeds effects are not visible for 7 days or more. Plants that have not begun to grow but have live underground root stocks are not affected by the herbicide and will continue to grow. Glyphosate does not provide residual weed control (Agriliance 2005).

An application rate of up to 12 ounces per acre for imazapic mixed with up to 16 ounces per area for glyphosate would control both pre-emergent cheatgrass and cheatgrass after it has begun to grow. The low per acre application rate for glyphosate could cause minimal damage to emerging native perennial

plants and is not likely to kill the perennial native plants (personal communication, Ken Holsinger). The low per acre application rate is designed to only affect annual plants.

Research conducted in many areas throughout the Great Basin and Intermountain West found that cheatgrass can be reduced by more than 90 percent the first year after treatment (BASF 2003b) with 12 ounces per acre fall application rates of imazapic, but there are more non-target impacts to desirable plants at these higher application rates as well as with spring season application. Conditions within the Dakota Hill project area are ideal for treatment because the fire removed most of the overstory and ground cover which exposes mineral soil.

Ideally, the release of the native plant species from cheatgrass competition coupled with the availability of suitable germination sites and increased soil fertility soil that result from the fire, would allow the native species to become established and increase their competitive capacity for subsequent growing seasons. As cheatgrass seedbanks are relatively short lived, and most cheatgrass seed either germinates and grows or is not viable after 1 year (Meyer 2003), the suppression of cheatgrass germination for 3 years as a result of the imazapic treatment should provide adequate time for the native plant communities to re-establish. Once that native plant community is firmly re-established, it would be more resistant to wholesale cheatgrass invasion, although careful monitoring and follow-up spot treatments along invasion corridors would still be needed.

Long-term, the herbicide treatment would interrupt the grass-fire cycle, which would allow native plant communities to regenerate and persist. This would preserve the fullest complement of native plant species, communities, and ecosystem processes. Before the fire, there were still intact native plant communities throughout the burned area so it is expected that the seedbanks of the native species are viable enough to re-establish and perpetuate native communities in the project area if cheatgrass is controlled and the grass-fire cycle interrupted at this early stage. These healthy native plant communities would be more resistant to future cheatgrass invasion from surrounding lands. In the absence of cheatgrass, future fires in the project area would be within the natural fire regime and therefore would be less frequent, smaller in size, and lower in intensity than fires that burn in cheatgrass environments. The primary reasons for this difference are due to later green-up and die-back of native species—providing less available dry fuels, and to the discontinuous spacing of fuel and the percent bare ground that naturally exists in the Great Basin and Colorado Plateau shrubland and woodland environments. These intershrub spaces are also important for the colonization or succession of biological soil crusts.

Cumulative Impacts. The proposed action as well as yellow star thistle monitoring and control, and sensitive plant monitoring, control of non-native plant species, stabilization of Cabin Spring, and the Pine Valley Peak prescribed fire would all help to restore and maintain native plant species and communities. The replacement of the boundary fence would indirectly help protect recovering plants in the burned area from impacts caused by illegal off-road vehicles or trespass livestock grazing.

The actions associated with emergency stabilization after the Dakota Hill fire including the trail reconstruction and clearing, and hazard tree removal would have some positive affect to vegetation communities in general.

The no action alternative does not have any relationship to or would affect the rehabilitation of the lower West Rim Trail.

Overall, impacts of the proposed action when added to the impacts of other actions affecting vegetation, would result in short-term, minor cumulative negative impacts to some plants and long-term moderate or cumulative positive impacts to native plant communities and populations.

Conclusion. The proposed action would result in short-term, minor negative impacts to some native plants due to herbicide exposure and long-term, moderate positive impacts due to perpetuation of native shrublands and woodlands.

Impairment. Because there would be no major, adverse impacts to vegetation whose conservation is (1) necessary to fulfill specific purposes identified in the established legislation of Zion; (2) key to the natural or cultural integrity of the park; or (3) identified as a goal in the park's GMP or other relevant NPS planning documents, there would be no impairment to the park's vegetation resources from the implementation of Alternative B.

Threatened, Endangered, and Sensitive Plant Species

Affected Environment

One federally-listed endangered plant species, the Shivwits milkvetch (*Astragalus ampullarioides*), occurs in ZION. This species was listed in 2001 by the U.S. Fish and Wildlife Service (USFWS) because of its extremely limited range on the Chinle formation and its rapidly vanishing habitat due to development (USFWS 2001). The Recovery Plan for Shivwits milkvetch was finalized in September 2006. On December 27, 2006 the USFWS designated 2,421 acres of critical habitat for Shivwits milkvetch; with almost half of those acres, 1,201 acres, within the park (USFWS 2006).

The identification of critical habitat is based on data available at the time of designation. The focus for critical habitat is on the physical and biological features essential to the conservation of the species, which are referred to as the primary constituent elements, that are within areas occupied by the species at the time of listing, and that may require special management considerations and protection. The primary constituent elements for Shivwits milkvetch are: outcroppings of soft clay soil within the Chinle and less commonly the Moenave formations at elevations from 3,018 to 4,367 feet; topographic features/relief including alluvial fans and fan terraces and gently rolling to steep swales with little to moderate slope that are often markedly dissected by water flow pathways from seasonal precipitation; and the presence of insect visitors or pollinators.

Informal consultation with the USFWS specific to the Dakota Hill Complex and Kolob fire has indicated that there are no populations of this plant within the project areas and it is unlikely that any suitable habitat for this species exists within the project area.

Zion also hosts 22 plant species considered "sensitive" by the park and the state of Utah because of their limited distribution (endemism) or are disjunct from more abundant population centers. Table 7 lists the species known to occur in the areas burned by both the Dakota Fire Complex and the Kolob fire.

Table 7: Sensitive Species by Habitat

Common Name	Scientific Name	Family	Habitat	Fire-prone Habitat	Present
Clark's lomatium	*Lomatium graveolens* var. *clarkia*	Apiacea	Ponderosa pine forest understory or pinyon pine understory	Yes	Dakota East
Higgin's penstemon	*Penstemon leonardii* var. *higginsii*	*Scrophulariaceae*	Ponderosa pine forest understory or pinyon pine understory	Yes	Dakota West
Charleston's violet	*Viola charlestonensis*	*Violaceae*	Ponderosa pine forest understory or pinyon pine understory	Yes	Dakota East Dakota West

Table 7: Sensitive Species by Habitat					
Common Name	**Scientific Name**	**Family**	**Habitat**	**Fire-prone Habitat**	**Present**
			Exposed limestone[1]	Rare	
Panguitch buckwheat	*Erogonum panguicense*	*Polygonaceae*	Exposed limestone[1]	Rare	Dakota East
Jone's goldenaster	*Heterotheca jinesii*	*Asteraceae*	Sandstone soils & crevices[1]	Rare	Dakota West
Zion draba	*Draba asperella*	*Brassicaceae*	Sandstone soils & crevices[1]	Rare	Dakota West
Canaan daisy	*Erigeron canaani*	*Asteraceae*	Sandstone soils & crevices[1]	Rare	Dakota West
Zion penstemon	*Penstemon humilis* var. *obtusifolius*	*Scrophulariaceae*	Sandstone soils & crevices[1]	Rare	Dakota West Kolob Fire
			Ponderosa pine forest understory or pinyon pine understory	Yes	
Foster's columbine	*Aquilegia formosa* var. *fosteri*	*Ranunculaces*	Hanging garden or wetland	Rare	Dakota West
Zion daisy	*Erigeron sionis*	*Asteraceae*	Hanging garden or wetland	Rare	Dakota West Kolob Fire
Religious daisy	*Erigeron religiosus*	*Asteraceae*	Dry meadows	Yes	Kolob Fire
Shivwits milkvetch	*Astragalus ampullarioides*	*Fabaceae*	Chinle Formation[1]	Rare	Kolob Fire
[1] Habitat not fire-prone, but with invasion of red brome fire frequency can dramatically increase					

Impact Threshold Definitions

Negligible	No federally listed species or sensitive species would be affected or the alternative would affect an individual of a listed species, its critical habitat, or a sensitive species, but the change would be so small that it would not be of any measurable or perceptible consequence to the protected individual or its population.
Minor	The alternative would affect an individual(s) of a listed species, its critical habitat, or a sensitive species, but the change would be small.
Moderate	An individual or population of a listed species, its critical habitat, or a sensitive species would be noticeably affected. The effect would have some consequence to the individual, population, or habitat.
Major	An individual or population of a listed species, its critical habitat, or a sensitive species would be noticeably affected with a vital consequence to the individual, population, or habitat.
Duration	Short-term - recovers in less than one year
	Long-term – requires more than one year to recover
Area of Analysis	Within and immediately adjacent to the project areas inside the park boundary

Effects of Alternative A – No Action Alternative

Federally Listed Species. Shivwits mikvetch is not known to occur within the Dakota Hill treatment area. And since the geologic substrate that supports the species is very limited in the area of the proposed re-treatment for the Kolob fire, it is very unlikely that there are unknown populations of Shivwits milkvetch in the treatment area. There is no critical habitat in either treatment area.

The 2006 post-fire herbicide treatments, associated with the Kolob fire, in the areas near Shivwits critical habitat were successful and are not proposed for re-treatment. Long-term, these treatments would interrupt the grass-fire cycle, which would reduce the likelihood of uncontrolled fire in general which may help preserve Shivwits milkvetch populations or critical habitat. By restoring natural fire regimes and not allowing for the cheatgrass-driven increased fire frequency, fire size, and fire intensity and the resulting fire suppression effort, the populations of this species outside the project area would likely benefit.

State-Listed or Other Sensitive Species. Since aerial application of herbicide would not be undertaken in the no action alternative, there would be no short-term impacts to state-listed or other sensitive plant species in the project area.

Long-term, the lack of treatment would allow the grass-fire cycle to be perpetuated and overtime the native woodlands and shrublands could be replaced by invasive grasslands. The perpetuation of the grass-fire cycle in the project area could lead to increased fuel loads and cheatgrass invasion could alter the suitability of the habitat for these species. These changes could result in long-term negative impacts to this species due to increased fire frequency, fire size, and fire intensity and the resulting fire suppression effort. As the Zion penstemon, Clark's lomatium, Higgin's penstemon, Charleston's violet, and religious daisy occur in fire-prone habitats, they would be most directly impacted by the increased flammability of the landscape. Together these increased fire effects and fire suppression effects are likely to negatively impact state-listed or other sensitive plant species both within the project area and potentially into surrounding areas.

Cumulative Impacts. Implementation of the no action alternative would mean that aerial herbicide application would not occur and the grass-fire cycle would be perpetuated, which would reduce the effectiveness of other projects: yellow star thistle monitoring and control, sensitive plant monitoring and control of non-native plant species, and the Pine Valley Peak prescribed burn.

The actions associated with emergency stabilization after the Dakota Hill fire including replacement of the boundary fence, the stabilization of Cabin Spring, trail reconstruction and clearing, and hazard tree removal would still have some positive affect to vegetation communities in general which would indirectly have a positive effect on sensitive plant species.

The no action alternative does not have any relationship to or would affect the rehabilitation of the lower West Rim Trail.

Overall, impacts of the no action alternative when added to the impacts of other actions affecting vegetation, would result in long-term, moderate negative cumulative impacts to threatened, endangered, and sensitive plant species.

Conclusion. Implementation of the no action alternative would result in no short-term impacts to threatened, endangered, and sensitive plant species. The no action alternative could result in long-term, minor to moderate negative impacts to sensitive plants due to perpetuation of the grass-fire cycle.

Effects Determination. Since 2006 post-fire treatments in the area near Shivwits milkvetch critical habitat were successful, implementation of the no action alternative would have **no effect** on Shivwits milkvetch plants or populations. There are no actions proposed in Alternative A that would occur in or near critical habitat and therefore would not alter any of the primary constituent elements. Alternative A would not be anticipated to diminish the contribution of the constituent elements of critical habitat for the

recovery of Shivwits milkvetch. The implementation of Alternative A would **not result in reduction or adverse modification for Shivwits milkvetch critical habitat.**

Impairment. Because there would be no major, adverse impacts to threatened and endangered plant species or sensitive plant species whose conservation is (1) necessary to fulfill specific purposes identified in the established legislation of Zion; (2) key to the natural or cultural integrity of the park; or (3) identified as a goal in the park's GMP or other relevant NPS planning documents, there would be no impairment to the park's threatened and endangered plant species or other sensitive plants from the implementation of Alternative A.

Effects of Alternative B – Proposed Action/Preferred Alternative

Federally Listed Species. There are no known Shivwits milkvetch populations within the Dakota Hill Complex treatment area. And since the geologic substrate that supports the species is very limited in the Kolob fire area proposed for re-treatment, it is very unlikely that there are unknown populations of Shivwits milkvetch in the treatment area. However, if the plants exist within the re-treatment area it is unlikely they would be affected by the proposed action. This is because the proposed action would occur when Shivwits milkvetch is dormant – the plant must be growing to be affected by glyphosate, and imazapic is not likely to affect non-germinated seeds. There is no critical habitat in either treatment area.

Long-term, the herbicide treatment would interrupt the grass-fire cycle, which would reduce the flammability of the landscape in general which may help preserve Shivwits milkvetch populations or suitable habitats outside of the project area. By restoring natural fire regimes and not allowing for the cheatgrass-driven increased fire frequency, fire size, and fire intensity and the resulting fire suppression effort, the populations of this species outside the project area would likely benefit.

State-Listed or Other Sensitive Species.

Under the proposed action, all wetland, riparian, and surface waters would not be sprayed with herbicides. Since the Zion daisy and Foster's columbine occur in wetland habitats there would be no direct effect to the species from the implementation of the proposed action.

Panguitch buckwheat, Jone's goldenaster, Zion draba, and Canaan daisy generally occur on sandstone soils, in sandstone crevices, or on exposed limestone. For the most part these areas do not support much vegetation, and therefore would not be targeted as part of the aerial spray application. Since herbicide applications for the Dakota fire are limited to the most severely burned areas, which would not yet be vegetated if the herbicide was applied fall 2007, it is not likely that any of these plants would be exposed to the herbicides. If sprayed in the spring, all sensitive plant locations would be mapped and avoided. Therefore, there would be no effect to these sensitive plant species from the proposed action.

The religious daisy occurs in dry meadow habitats that were likely affected by the Kolob fire. This species is an annual or short-lived perennial that flowers May through September, so it would not be exposed to foliar application of herbicide if applied in winter as proposed. This species has not been tested for it's tolerance to the proposed herbicides, and there is no published research that addresses general tolerance of the genera *Erigeron*. Reported tolerances for the family *Asteraceae* are widely variable, with some species demonstrating full tolerance, while others show some level of suppression or negative affect, and others are intolerant. As this species is widespread in ZION and there are many extant populations, any loss of plants in the project area would be unlikely to affect the conservation status of this species or noticeably reduce its distribution or genetic diversity.

Clark's lomatium, Higgin's penstemon, Charleston's violet, and Zion penstemon all occur in the understory of ponderosa pine or pinyon pine woodlands. Both the ponderosa pine and pinyon pine plant communities were affected by the Dakota Hill and Kolob fires. These sensitive plant species are perennial and flower May through September. Since herbicide applications for the Dakota fire are limited to the most severely burned areas, which would not yet be vegetated if the herbicide was applied fall 2007, it is not likely that any of these plants would be exposed to the herbicides. If herbicides were to be applied in the spring in the Dakota Hill area, all plant locations would be mapped and avoided. The herbicide applications in the Kolob re-treatment area would occur in winter when these plants would not be exposed to foliar application. Therefore there would be no affect to these sensitive plant species from the proposed action.

Long-term, the herbicide treatment would interrupt the grass-fire cycle. By restoring natural fire regimes and not allowing for the cheatgrass-driven increased fire frequency, fire size, and fire intensity and the resulting fire suppression effort, the populations of these species would likely benefit.

Cumulative Impacts. The proposed action as well as yellow star thistle monitoring and control, sensitive plant monitoring and control of non-native plant species, and the Pine Valley Peak prescribed burn would all help to restore and maintain native plant species and communities. The replacement of the boundary fence would indirectly help protect recovering plants in the burned area from impacts caused by illegal off-road vehicles or trespass livestock grazing.

The actions associated with emergency stabilization after the Dakota Hill fire including the stabilization of Cabin Spring, trail reconstruction and clearing, and hazard tree removal would have some positive affect to vegetation communities in general.

The proposed action does not have any relationship to or would affect the rehabilitation of the lower West Rim Trail.

Overall, impacts of the actions described under the proposed action added to the impacts of other actions affecting threatened, endangered, and sensitive plant species, could result in short-term, minor negative cumulative impacts to some individual plants and long-term, moderate positive cumulative impacts to threatened, endangered, and sensitive plant individuals and populations.

Conclusion. The proposed action could result in short-term, minor negative impacts to some state listed plants due to herbicide exposure. Long-term, moderate positive impacts would be seen due to perpetuation of native plant communities and suitable habitat for listed plant species.

Effects Determination. Implementation of the proposed action would have **no effect** on Shivwits milkvetch individual plants or populations. There are no actions proposed in Alternative B that would occur in critical habitat and therefore would not alter any of the primary constituent elements. Alternative B would not be anticipated to diminish the contribution of the constituent elements of critical habitat for the recovery of Shivwits milkvetch. The implementation of Alternative B would **not result in reduction or adverse modification for Shivwits milkvetch critical habitat.**

Impairment. Because there would be no major, adverse impacts to threatened and endangered plant species or sensitive plant species whose conservation is (1) necessary to fulfill specific purposes identified in the established legislation of Zion; (2) key to the natural or cultural integrity of the park; or (3) identified as a goal in the park's GMP or other relevant NPS planning documents, there would be no impairment to the park's threatened and endangered plant species or other sensitive plants from the implementation of Alternative B.

Wildlife

Affected Environment

The diverse vegetation communities within ZION support a variety of wildlife species. ZION is home to 6 species of amphibians, 28 species of reptiles, 79 mammal species, 289 bird species, and 7 fish species. Nevertheless, the inventory of wildlife in the park is incomplete. Particularly understudied are biologically rare species, nocturnal species, and the many invertebrate species.

Many species of birds and some mammal species, such as bats, are migratory. Consequently, the number of species and the size of populations vary considerably from season to season and place to place. Prior to Dakota Hill Complex and the Kolob fires, some of the most commonly sighted animals in the area that burned included mule deer, coyote, mountain lion, raptors, lizards, and rodents. Generally, animals that are highly mobile, such as large mammals and adult birds, are able to flee from the fire while burrowing animals escape the fire by going underground where the heat of the fire does not penetrate. Other animals, particularly rabbits and reptiles, lack these escape strategies and commonly perish in fires. After the fire, animals that use the area must adjust to the burned landscape. In some cases, animals move into nearby unburned areas. Others find short-term shelter and wait for the vegetation to recover. Some animals, specifically ungulates and raptors, are known to seek out newly burned areas because of the food availability and, in the case of ungulates, the mineral nutrition that can be found in ash. Since the Kolob fire, fresh sign of mountain lion as well as raptors and lizards have been found in the burned area. Long-term recovery of the burned area and the quality and variety of habitats it may provide in the future is probably the most important factor in sustaining native wildlife populations in the area.

Seed-eating animals, called granivores, play vital roles in desert ecosystems. The most common granivores in the desert are rodents, ants, and, to a lesser extent, birds. Granivores have been studied in both the Mojave and Sonoran Deserts and have been found to be very influential in the re-establishment of vegetation after fire (Esque et al. 2004a). The “caching” of seed by these animals is a primary means of distribution of seed from nearby unburned areas into burned landscapes. However, rodents and other herbivores are also known to greatly reduce the viability of perennial woody plants that re-sprout after fire because these re-sprouts often represent the only food sources available in the burned area and they are sometimes eaten as quickly as they grow (Esque et al. 2004b). The ability to withstand this increased herbivory varies by species and is also affected by the growing conditions of the site. Thus the relationship between animals, especially granivores and herbivores, and the recovery of burned lands is complicated.

ZION has four native fish species and few invasive exotic fish. This is because park streams retain natural flow regimes, there have been few introductions of exotic fish, and the native species are well adapted to the sediment laden floods that frequently occur while the exotic species are not.

All four native fish occur either in North Creek or the Virgin River. The fish species include: flannelmouth sucker (*Catostomus latipinnis*), speckled dace (*Rhinichthys osculus*), desert sucker (*Catostomus clarkia*), and Virgin River spinedace (*Lepidomeda mollispinis mollispinis*). Both the spinedace and the flannelmouth sucker are managed under conservation agreements in lieu of listing, so are considered special status species and discussed in the section of this document titled *Threatened, Endangered, and Sensitive Animal Species*.

Impact Threshold Definitions

Negligible	Wildlife would not be affected or the effects would be at or below the level of detection and the changes would be so slight that they would not be of any measurable or perceptible consequence to the wildlife species' population.
Minor	Effects to wildlife would be detectable, although the effects would be localized, small, and of little consequence to the species' population. Mitigation measures, if needed to offset adverse effects, would be simple and successful.
Moderate	Effects to wildlife would be readily detectable, localized, and with consequences at the population level. Mitigation measures, if needed to offset adverse effects, would be extensive and likely successful.
Major	Effects to wildlife would be obvious and would have substantial consequences to wildlife populations in the region. Extensive mitigation measures would be needed to offset any adverse effects and their success would not be guaranteed.
Duration	Short-term – recovers in less than one year
	Long-term – requires more than one year to recover
Area of Analysis	Within and immediately adjacent to the project areas inside the park boundary

Effects of Alternative A – No Action Alternative

Since aerial application of herbicide would not be undertaken in the no action alternative, there would be no short-term impacts to animals or wildlife habitat in the project area.

Long-term, the lack of treatment would allow the grass-fire cycle to be perpetuated and overtime the wildlife habitat would be degraded due to cheatgrass invasion. Cheatgrass provides little forage value and is not palatable during most of the summer months due to their sharp awns (Mosley 1999). As cheatgrass invasion increases fire frequency, fire size, and fire intensity, animals would suffer increased mortality due to fire or fire suppression effects. Furthermore, the grass-fire cycle would eventually degrade the native plant communities which results in habitat alteration and even the loss of some habitats. The most noticeable change would be alteration of the habitat structure as woodlands and shrublands are eventually converted into grasslands. Granivores would be especially affected because the variety of seed would be greatly reduced and the ground surface, where ants and rodents tend to live, would be covered in thatch. The conversion to grassland would also cause displacement of animals into surrounding areas, however, cheatgrass invasion has already altered tens of millions of acres in the Intermountain West, so the availability of suitable habitat may be insufficient to support the current population sizes and species composition that exist now. Overtime, less mobile and less resilient species would be extirpated and those populations remaining in a cheatgrass dominated landscape would likely be reduced in size and vigor.

Cumulative Impacts. Implementation of the no action alternative would mean that aerial herbicide application would not occur and the grass-fire cycle would be perpetuated, which would reduce the effectiveness of two other projects: yellow star thistle monitoring and control, and sensitive plant monitoring and control of non-native species. The resulting increase in fires would likely result in wide-spread losses of native wildlife habitat. This could increase negative effects to wildlife species and their habitats by other proposed actions such as the Pine Valley Peak prescribed burn.

The no action alternative would not impact actions associated with the Dakota Hill Complex emergency stabilization. This includes the boundary fence reconstruction, stabilization of Cabin Spring, trail reconstruction and clearing, and hazard tree removal, or other unrelated actions such as the lower West Rim trail reconstruction.

Overall, impacts of no action added to the impacts of other actions affecting wildlife, would result in long-term, moderate negative cumulative impacts to wildlife populations and habitat.

Conclusion. Implementation of the no action alternative would result in no short-term impacts to wildlife, but would result in long-term, moderate negative impacts to wildlife habitat and increase the potential for mortality of animals due to perpetuation of the grass-fire cycle. The landscape level conversion of native woodlands and shrublands to invasive grasslands would alter wildlife habitat and reduce the species diversity and population health of many wildlife species.

Impairment. Because there would be no major, adverse impacts to wildlife whose conservation is (1) necessary to fulfill specific purposes identified in the established legislation of Zion; (2) key to the natural or cultural integrity of the park; or (3) identified as a goal in the park's GMP or other relevant NPS planning documents, there would be no impairment to the park's wildlife by the implementation of Alternative A.

Effects of Alternative B – Proposed Action/Preferred Alternative

Under this alternative, a helicopter would be working for approximately 2 weeks in each of the treatment areas (Dakota & Kolob) to complete the herbicide application. All helicopter work would take place during daylight hours. Animals in the treatment areas would likely respond to the noise from the helicopter and, while unlikely, some animals may be directly contacted with the herbicide mix as it is released from the helicopter. The nature of the response would vary by species and where the animal is in relation to the helicopter, but common responses might include immobilizing, fleeing to a burrow or crevice, or fleeing across the ground surface to vegetative cover. In all cases, the response would be very short in duration, probably lasting several minutes, and the extent of the response would be limited only to those animals near the helicopter.

Fall season is an important time for animals to put away food reserves for the oncoming winter, but it is not a particularly sensitive time for most species because the young of the year have generally had several months to mature and are highly mobile at this time of year. The exception would be animals that breed and birth continuously, such as some rodent and insect species. For these species, there could be pregnant females present and/or very young animals present. The potential for impact to these animals would be higher than for more mobile animals.

Those species that immobilize in response to an intrusion in their environment, such as the helicopter, are most likely to be directly exposed to the herbicide mix. Imazapic is neither an acute or chronic toxicant to mammals, birds, fish, aquatic invertebrates, or honey bees. Glyphosate is considered relatively nontoxic to domestic animals (Agriliance 2005). INDUCE® may cause gastrointestinal irritation if ingested in large quantities. It is also considered a moderate skin and eye irritant (HHC 2005).

Effects to other groups of animals were not specifically reported, but effects on herpetofauna and invertebrates (other than bees and aquatic) are likely to be similar. Studies have found that ingested imazapic is readily excreted unaltered in urine and feces so it does not bioaccumulate in the food chain (BASF 2006). This means that predators are not dosed with the chemical as a result of the prey that they consume. Imazapic does not persist in water because it binds to soil and any free chemical in water solution quickly photo degrades within hours (BASF 2006), so potential for wildlife consumption of contaminated water is very low.

Long-term, the herbicide treatment would interrupt the grass-fire cycle, which would allow native plant communities to regenerate and provide habitat for native wildlife. This would prevent cheatgrass from

dominating the landscape, thus preserving native woodland and shrubland habitats that provide high quality forage and habitat structure. Granivores would still have access to a wide variety of seeds. While the habitat requirements vary by species, sustainable native wildlife populations require native habitats. This would assure that native wildlife populations continue to thrive in the park.

Cumulative Impacts. The proposed action as well yellow star thistle monitoring and control, the sensitive plant monitoring and control of non-native species, stabilization of Cabin Spring, and the proposed Pine Valley prescribed burn would all maintain native plant communities and water sources which serve as wildlife habitat. The replacement of the boundary fence would indirectly help protect recovering habitats and animals present in the burned area from impacts caused by illegal off-road vehicles or trespass livestock grazing.

Helicopter use associated with the proposed action, as well as the reconstruction of the West Rim Trail (both upper and lower) and the fence repair could have a minor, negative impact to wildlife in the short-term.

Overall, impacts of the actions described under the proposed action added to the impacts of other actions affecting wildlife, would result in short-term, minor cumulative negative impacts to some individual animals and long-term moderate cumulative positive impacts to wildlife habitat.

Conclusion. The proposed action would result in short-term, minor negative impacts to some animals due to herbicide exposure and response to the helicopter. There would be long-term, moderate positive impacts due to perpetuation of native shrublands and woodlands and maintaining native grasses which provide wildlife habitat.

Impairment. Because there would be no major, adverse impacts to wildlife whose conservation is (1) necessary to fulfill specific purposes identified in the established legislation of Zion; (2) key to the natural or cultural integrity of the park; or (3) identified as a goal in the park's GMP or other relevant NPS planning documents, there would be no impairment to the park's wildlife by the implementation of Alternative B.

Threatened, Endangered, and Sensitive Animal Species

Affected Environment

The analysis for this EA will only address those species that are either in the project area or could be affected by the actions proposed. The Biological Assessment associated with this EA addresses all threatened, endangered, or sensitive animal species in the park. The species addressed in this EA include: Mexican spotted owl (*Strix occidentalis lucida*), California condor (*Glymnogyps californianus*), peregrine falcon (*Falco peregrinus anatum*), Virgin spinedace (*Lepidomeda mollispinis mollispinis*), flannelmouth sucker (*Catostomus latipinnis*), Virgin River chub (*Gila seminude*), and woundfin (*Plagopterus argentissimus*).

ZION is within the Colorado Plateau Recovery Unit for the Mexican spotted owl (*Strix occidentalis lucida*) which is listed as a threatened species. The Mexican spotted owl reaches the northwestern limits of its range in this recovery unit (USFWS 1995), and all of ZION is designated as critical habitat for this species (USFWS 2004). Mexican spotted owls in southern Utah primarily use steep-walled rocky canyons (USFWS 1995). Monitoring at ZION has confirmed this habitat association, finding core owl nesting and roosting areas below canyon rims in area with narrow canyon floors and high vertical walls that contain

protected ledges, fractures, or caves. These "slot canyons" provide cooler microclimates that may be favored by owls (Rinkevich 1991).

The following background information comes from the Biological Opinion issued for the FMP by the Utah Field Office in February 2005 (USFWS 2005).

> *The entirety of Zion National Park is designated critical habitat for Mexican spotted owl. Primary constituent elements related to critical habitat in Utah include one or more of the following: (1) presence of water (often providing cooler temperatures and higher humidity than the surrounding areas); (2) clumps or stringers of mixed conifer, pine-oak, pinyon-juniper, and/or riparian vegetation; (3) canyon wall containing crevices, ledges, or caves; and (4) high percent of ground litter and woody debris. The primary constituent elements provide a qualitative description of those physical and biological features necessary to ensure the conservation of the owl in Utah (50 FR 53182).*

A Mexican spotted owl monitoring program for the park was initiated in 1995. The park has confirmed 32 core areas, including 26 which have been active in recent years and 6 historical sites. Core boundaries are drawn around owl detection locations which have been identified through call-response surveys. Because exact nest locations are unknown, the cores are delineated as relatively large areas surrounding best roosting/nesting habitat. In 2006 and 2007 the park conducted monitoring on 26 cores, including 2 new cores found in 2006 (A. Bruner, personal communication).

A non-essential experimental population (Section 10(j) of the Endangered Species Act) of the federally endangered California condor (*Gymnogyps californianus*) was reintroduced into northern Arizona in 1996 (USFWS 1996). The condor must be treated as a listed threatened species under the 10(j) designation in the park. Since the summer of 2004, groups of condors have used the area north of the park near Kolob Reservoir and have been known to regularly venture into the park. Condors were observed in the main canyon in the summer of 2006. The condors appear to be expanding their range farther north from the northern Arizona reintroduction site, and may be expected to visit ZION more frequently in the future. They currently are not known to use the park year-round, and do not use the park as a breeding area.

Two fish species listed as endangered, the Virgin River chub (*Gila seminude*) and woundfin (*Plagopterus argentissimus*) are found in the Virgin River several miles downstream of the project areas. Though early records are limited, it appears that these two species never occurred much upstream of the Timpoweap Canyon and Pah Temp Hot Spring, both well downstream of the park.

The following sensitive animal species occur either in or adjacent to the project areas.

Although the peregrine falcon (*Falco peregrinus anatum*) was removed from the federal list of endangered and threatened species in 1999, ZION continues to monitor territories associated with climbing routes. ZION is known to have 19 historic falcon territories. A subset of those territories and the climbing route territories are monitored each year (B. Hetzler, personal communication). Each year areas with known nest sites are closed to visitor use at the beginning of the nesting season. If a nest site is not used, the area is opened to visitor use. In areas where the nest sites are used, the areas are closed to visitor use until the young falcons have fledged. Peregrine falcons prey on other bird species, usually capturing their prey in mid-flight.

The Virgin spinedace (*Lepidomeda mollispinis mollispinis*) and flannelmouth sucker (*Catostomus latipinnis*) are both managed under Conservation Agreements in lieu of listing as a threatened or endangered species. Both fish have similar ranges in the park and are found in the North Fork and East Fork of the Virgin River and several short tributaries within Zion and Parunuweap Canyons. They are

found downstream of the park in North Creek and LaVerkin Creek. Since 1994, the Utah Division of Wildlife Resources has been monitoring these fish at two park locations. Monitoring would continue annually.

Impact Threshold Definitions

Negligible	No federally listed species or sensitive species would be affected, or the alternative would affect an individual of a listed species, its critical habitat, or sensitive species, but the change would be so small that it would not be of any measurable or perceptible consequence to the protected individual or its population.
Minor	The alternative would affect an individual(s) of a listed species, its critical habitat, or sensitive species, but the change would be small.
Moderate	An individual or population of a listed species, its critical habitat, or sensitive species would be noticeably affected. The effect would have some consequence to the individual, population, or habitat.
Major	An individual or population of a listed species, its critical habitat, or sensitive species would be noticeably affected with a vital consequence to the individual, population, or habitat.
Duration	Short-term - recovers in less than one year
	Long-term – requires more than one year to recover
Area of Analysis	Within and immediately adjacent to the project areas inside the park boundary

Effects of Alternative A – No Action Alternative

Federally Listed Species. Since aerial application of herbicide would not be undertaken in the no action alternative, there would be no short-term impacts to the Mexican spotted owl or its habitat, California condor, Virgin River chub, or woundfin.

Mexican Spotted Owl. Long-term, the lack of treatment would allow the grass-fire cycle to be perpetuated and overtime the owl's habitat could be degraded due to cheatgrass invasion. The most direct effect would be an alteration of the prey base as some rodent populations could be reduced in a cheatgrass dominated landscape. Secondarily, the ability of the owls to detect and capture rodents could be diminished due to the thick ground cover and thatch that exist in cheatgrass grasslands. Additionally, as cheatgrass invasion would result in increased fire frequency, fire size, and fire intensity, trees available for roosting and cover could eventually be reduced or even eliminated, from the landscape. These factors could reduce the distribution of two of the four constituent elements of the owl critical habitat: (1) clumps or stringers of mixed conifer, pine-oak, pinyon-juniper, and/or riparian vegetation; and (2) high percent of ground litter and woody debris.

California Condor. Without treatment, the grass-fire cycle would continue. Increase in wildland fire activity could increase the use of aircraft to fight those fires which could affect condors. Generally, because condors are highly mobile birds that travel large distances, the potential for direct impacts to condors from the low flying aircraft would be minimal. Habitat conditions would deteriorate if burned repeatedly. Which means condors would probably find more suitable habitat.

Virgin River Chub and Woundfin. Since cheatgrass would not be controlled, it is assumed that wildland fire would increase in frequency and intensity. This could give way to increased erosion, especially on steeper slopes. Water quality would experience short-term increases in sediment loading, nutrients, ash and pH with each major fire typically lasting 1 to 2 years. Since native fish have evolved with high sediment loading, the long-term effects if any would be minimal.

State-Listed or Other Sensitive Species. Since aerial application of herbicide would not be undertaken in the no action alternative, there would be no short-term impacts to the peregrine falcon or its habitat, or the Virgin spinedace and flannelmouth sucker or their habitat.

Long-term, the lack of treatment would allow the grass-fire cycle to be perpetuated and overtime the habitat for these species could be degraded due to cheatgrass invasion. As cheatgrass invasion would result in increased fire frequency, fire size, and fire intensity, there could be a loss of the woodlands and shrublands that provide habitat for the bird species that serve as prey for the peregrine falcons. This reduction in prey base could reduce the suitability of the habitat for peregrine falcons and could decrease the number of birds the area could support. Increased fire also means increased post-fire watershed effects which could reduce the habitat quality of the Virgin spinedace and flannelmouth sucker downstream of the project area. The primary influence would be changes in water chemistry and turbidity that result from increased sediment and ash transport into streams from burned areas. The degree to which these watershed events could cause direct mortality of fish or reduce the suitability of their habitat would vary based on the magnitude and duration of the watershed event and the life stage of the fish at the time of the event.

Cumulative Impacts. Implementation of the no action alternative would mean that aerial herbicide application would not occur and the grass-fire cycle would be perpetuated, which would reduce the effectiveness of other projects: yellow star thistle monitoring and control, the sensitive plant monitoring and control of non-native species, stabilization of Cabin Spring, and the proposed Pine Valley prescribed burn. The resulting increase in flammability of the landscape and degradation of native plant communities would likely reduce the capacity of the habitat for threatened, endangered, and sensitive animal species. The replacement of the boundary fence would indirectly help protect recovering habitats and animals present in the burned area from impacts caused by illegal off-road vehicles or trespass livestock grazing. Helicopter use associated with the proposed action, as well as the reconstruction of the West Rim Trail (both upper and lower) and the fence repair could have a minor, negatively impact wildlife in the short-term.

Overall, impacts of no action added to the impacts of other actions affecting wildlife and habitat, would result in long-term, moderate cumulative negative impacts to threatened, endangered, and sensitive animal species through habitat alteration.

Conclusion. Implementation of the no action alternative would result in no short-term impacts to threatened, endangered, and sensitive animal species, but could result in long-term, minor to moderate negative impacts to these animals due to perpetuation of the grass-fire cycle. The landscape level conversion of native woodlands and shrublands to invasive grasslands could reduce some habit components that currently support Mexican spotted owl and peregrine falcon. It could also contribute to the loss of these bird species in adjacent lands and could have negative impacts to the habitat of the fish species downstream of the project area.

Effects Determination. Implementation of the no action alternative could result in long-term, minor to moderate negative impacts to Mexican spotted owl due to perpetuation of the grass-fire cycle. Therefore the no action alternative **may affect, not likely to adversely affect** Mexican spotted owls. Under the no action alternative, the primary constituent elements that contribute to Mexican spotted owl critical habitat could be affected, although it is not anticipated that this would diminish the contribution of the constituent elements of critical habitat for the recovery of Mexican spotted owl. Overall, the implementation of the no action alternative would **not result in reduction or adverse modification for Mexican spotted owl critical habitat**.

Implementation of the no action alternative could result in long-term, minor to moderate negative impacts to California condor due to perpetuation of the grass-fire cycle. Therefore, the implementation of the no action alternative **may affect, not likely to adversely affect** California condors.

The Virgin River chub and the woundfin do not occur in the park or immediately downstream, based on staff knowledge and past surveys. The Virgin River chub has the closest known distribution to the park (Virgin River below the town of LaVerkin – approximately 20 miles down stream from the park), but is far enough downstream that any water quality effects related to the proposed action would be reduced with time and distance from the activity. Therefore, implementation of the no action alternative would not affect these species, resulting in a **no effect** determination.

Impairment. Because there would be no major, adverse impacts to threatened and endangered animal species or sensitive animals whose conservation is (1) necessary to fulfill specific purposes identified in the established legislation of Zion; (2) key to the natural or cultural integrity of the park; or (3) identified as a goal in the park's GMP or other relevant NPS planning documents, there would be no impairment to the park's threatened and endangered animal species or other sensitive animals by implementation of Alternative A.

Effects of Alternative B – Proposed Action/Preferred Alternative

Federally Listed Species.

Mexican Spotted Owl. Effects to Mexican spotted owls from the proposed herbicide treatments are expected to be nonexistent to negligible. Imazapic is not mutagenic or teratogenic and would not be expected to have any adverse effect on big game and non-game species when used as labeled (BASF 2004, BASF 2006). It is considered to be nontoxic to mammals, birds, fish, and aquatic invertebrates (BASF 2005, BASF 2006). The direct toxicity of pure glyphosate to mammals and birds is low. The dietary LD_{50} of glyphosate to mallards and bobwhite quail is greater than 4,500 parts per million (Kidd and James 1991).

Noise disturbance to Mexican spotted owls from the aerial operations involved with the herbicide treatment would be mitigated by several factors: 1) the general treatment areas are mesa-top plateau habitats, whereas owls are likely to be in below-rim canyon habitats during the daytime flights; 2) flights would be outside of a 0.5-mile buffer of known owl activity centers; 3) the season of treatment (from September 1 through February 28, with the optimal treatment period in mid October through late November) would lie outside the breeding season for Mexican spotted owls (March 1 – August 31) which would preclude foreseeable effects to owl reproduction; and 4) flights and noise disturbances would be a short-term duration (6 days of treatment x 6 flight hours per day, for 36 hours of project-wide impact), over a 2 week period.

The herbicide treatment to control for cheatgrass is expected to result in the maintenance of native grasses and forbs that support the owl's prey base of woodrats, mice, voles, and other small rodents — a beneficial effect. The proposed action may also result in adverse impacts due to noise and disruption of habitat for the owl and its prey species.

Long-term, the herbicide treatment would interrupt the grass-fire cycle, which would allow native plant communities to regenerate and provide habitat for native wildlife, including Mexican spotted owl. This would prevent cheatgrass from dominating the landscape, thus preserving native woodland and shrubland habitats that provide two of the four constituent elements of critical habitat for the species: (1) clumps or stringers of mixed conifer, pine-oak, pinyon-juniper, and/or riparian vegetation; and (2) high percent of ground litter and woody debris.

California Condor. Treatment of the Dakota Hills Complex project area would involve the use of a helispot at Lava Point, which is closest to the area that California condors typically use during the summer. Before initiating the project, park staff would contact personnel from the Peregrine Fund, who monitor California condors, and determine if birds are occupying the area from Lava Point south to the West fire.

Generally, because condors are highly mobile birds that travel large distances, the potential for direct impacts to condors from the helicopter used for aerial herbicide application is minimal. Noise from aircraft, expected to be approximately 6 days in duration over 2 weeks at Lava Point are disturbances that condors can avoid. Condors may also be attracted to areas with high levels of human activity and become habituated; however, the scale of this operation is small in human terms, and should not pose any attraction risks.

If condors are present in the area during the treatments, helicopter use, concentrated at the helispot may cause the short-term loss of foraging or roosting habitat for condors. However, condors should be able to avoid these disturbances with little, if any, negative effects. Beneficial effects are expected to occur, from overall improved habitat conditions, reduction of fire hazards, and prevention of cheatgrass-dominated systems. Disturbance from helicopter use for aerial herbicide treatments, and/or habituation to human activity resulting from the proposed action are not expected to adversely affect condors.

Virgin River Chub and Woundfin. Both the chub and woundfin are found 20 miles downstream from the park and are not likely to be affected by herbicide application, since water would not be sprayed with herbicide. The proposed treatment areas are at least 300 feet away from perennial streams and other surface waters. See the water resource section for more information on pathways for herbicide to enter streams and the impacts and fate of herbicide in water. Impacts, if any, to these fish from the proposed action would be negligible and short-term.

State-Listed or Other Sensitive Species. Under this alternative, a helicopter would be working for approximately 2 weeks at each of the project areas (Dakota & Kolob) to complete the herbicide application. During this time, peregrine falcons could be affected by the helicopter presence. Because adult birds are highly mobile, both the peregrine falcons and their prey birds would be expected to avoid the area where the helicopter is working at the time. For this reason, it is highly unlikely that either the falcons or their prey birds would be directly exposed to herbicide during application. As imazapic does not bioaccumulate, there would be no trophic effects on peregrine falcons. Also, the direct toxicity of pure glyphosate to mammals and birds is low.

There are no Virgin spinedace or flannelmouth in the project areas, although they do occur downstream. The proposed treatment areas are at least 300 feet away from perennial streams and other surface waters. See the water resource section for more information on pathways for herbicide to enter streams and the impacts and fate of herbicide in water. Impacts, if any, to these fish from the proposed action would be negligible and short-term.

Long-term, the herbicide treatment would interrupt the grass-fire cycle, which would allow native plant communities to regenerate and provide habitat for native wildlife. This would also improve habitat for the prey base of the peregrine falcon and preserve the water conditions and riparian vegetation needed to support Virgin spinedace and flannelmouth sucker.

Cumulative Impacts. The proposed action as well yellow star thistle monitoring and control, the sensitive plant monitoring and control of non-native species, stabilization of Cabin Spring, and the proposed Pine Valley prescribed burn would all maintain native plant communities and water sources which serve as wildlife habitat. The replacement of the boundary fence would indirectly help protect

recovering habitats and animals present in the burned area from impacts caused by illegal off-road vehicles or trespass livestock grazing.

Helicopter use associated with the proposed action, as well as the reconstruction of the West Rim Trail (both upper and lower) and the fence repair could have a minor, negative impact to protected wildlife species in the short-term.

Overall, impacts of the actions described under the proposed action added to the impacts of other actions affecting threatened, endangered, and sensitive animal species, would result in minor cumulative positive impacts to threatened, endangered, and sensitive animal species.

Conclusion. The proposed action would result in short-term, negligible negative impacts to threatened, endangered, and sensitive birds due to the noise generated by the helicopter and there would be no short-term impacts on fish species. There would be minor positive impacts to threatened, endangered, and sensitive animal species due to perpetuation of suitable habitat.

Effects Determination. Implementation of the proposed action would occur outside the critical breeding season and would occur outside any protected activity centers for Mexican spotted owl. Therefore, implementation of the proposed action **may affect, not likely to adversely affect** Mexican spotted owls. The treatment identified in the proposed action would have long-term benefits from improved habitat conditions, reduction of fire hazards, and prevention of cheatgrass-dominated systems. There are no proposed actions that would alter any of the primary constituent elements and therefore the proposed action is not anticipated to diminish the contribution of the constituent elements of critical habitat for the recovery of Mexican spotted owl. The implementation of the proposed action would **not result in reduction or adverse modification for Mexican spotted owl critical habitat**.

The proposed action is expected to provide long-term benefits to California condors from improved habitat conditions, reduction of fire hazards, and prevention of cheatgrass-dominated systems. Therefore, the implementation of the proposed action **may affect, not likely to adversely affect** California condors.

The Virgin River chub and the wounfin do not occur in the park or immediately downstream, based on staff knowledge and past surveys. The Virgin River chub has the closest known distribution to the park (Virgin River below the town of LaVerkin – approximately 20 miles down stream from the park), but is far enough downstream that any water quality effects related to the proposed action would be reduced with time and distance from the activity. Therefore, implementation of the proposed action would not affect these species, resulting in a **no effect** determination.

Impairment. Because there would be no major, adverse impacts to threatened and endangered animal species or sensitive animals whose conservation is (1) necessary to fulfill specific purposes identified in the established legislation of Zion; (2) key to the natural or cultural integrity of the park; or (3) identified as a goal in the park's GMP or other relevant NPS planning documents, there would be no impairment to the park's threatened and endangered animal species or other sensitive animals by implementation of Alternative B.

Soils

Affected Environment

The geologic formations within the burned area were created during the formation of the Colorado Plateau during the Mesozioc era. The major formations that occur within the burned areas from oldest to youngest are: Moenkopi, Chinle, Moenave, Kayenta, Navajo sandstone, Temple Cap, Carmel and Cedar Mountain formations. Formations from the Navajo sandstone and below are exposed in the Kolob fire area, while those from the Navajo sandstone and above are exposed in the east and west portions of the Dakota Hill Complex. The Kolob area also has Quaternary basalt flows and cinder cones, and Quaternary slide deposits. The Quaternary slide deposits include fragmented rock fall debris and talus materials cemented with calcite. Holocene (recent) alluvium deposits found in both the Dakota Hill and Kolob project areas occur in channels, floodplains and on stream terraces. These formations and surface materials are the parent materials for the soils in the area.

The Soil Survey of Washington County Area, Utah was used to obtain information on soils (USDA 1977). There are 9 soil maps units associated with the Dakota Hill complex and 22 soil map units that occur within the Kolob fire (Tables 8 & 9).

Table 8: Soil Map Units Within the Dakota Hill Complex Fire Burned Area

Soil Type	Percent of Soil Within Burned Area	Percent Slope	Pre-fire Water Erosion Hazard
Kolob-Detra association	27	2-40	Moderate
Pausaugunt gravely silt loam	14	30-50	Severe
Kinesave-Detra fine sandy loam	13	2-15	Slight
Rock outcrop: variable	13	Null	Not rated
Kolob-Hogg complex	11	2-8	Slight
Pausaugunt-Rock outcrop complex	9	2-30	Slight
Kinesave fine sandy loam	2	2-15	Slight
Badland, very steep	<1	Null	Not rated
Unknown	<1	Null	Null

Below are brief descriptions of the major soil map units that occur in the area of the Dakota Hill Complex:

Kolob-Detra association: consist of deep well-drained soils on mesa tops and mountain side slopes. These soils formed in material weathered from limestone and sandstone and have slopes ranging from 2 to 60 percent with Detra soils on slopes of less than 20 percent and the rockier Kolob soils on slopes greater than 20 percent. Common vegetation on Detra soil is big sagebrush and on Kolob soil is oak brush.

Paunsaugunt gravelly silt loam and Pausaugunt-rock outcrop complex: consists of shallow, gravelly, somewhat excessively drained soils that are underlain by bedrock at a depth of 10 to 19 inches. These soils are on north- and east-facing mountain side slopes in the area of Lava Point, along plateau margins and steeper draws in the east and west fires. Common vegetation includes ponderosa pine and pinyon-juniper.

Kinasava-Detra fine sandy loam: is mainly in and around mountain valleys with gentle slopes in the area of Potato Hollow in the west fire, and in association with Detra soils along the eastern park

boundary. Most of these valleys are areas of deep, dark loamy fine sand that is underlain by sandstone bedrock. Typical vegetation is oak brush on north exposures and pinyon-juniper or sage on flatter terrain.

Rock outcrop – variable: consists of exposures of bare bedrock, mostly sandstone, limestone, conglomerate, or basalt. This mapping unit is extensive throughout the survey area. Rock outcrop generally has no vegetation, but in some places stunted pinyon or ponderosa pines, or several shrub species grow in crevices or pockets of soil material. Generally a barrier to fire, though small pockets of vegetation can burn.

Kolob-Hogg complex: deep soils on relatively flat benches and mesas derived from sandstone. Kolob soils occur on mesa tops with slopes of 2 to 8 percent, are rocky at depths greater than 18 inches and have ponderosa pine as typical vegetation. Hogg soils occur on benches with slopes of 2 to 5 percent, are clayey at depth and have oak brush as typical vegetation.

Table 9: Soil Map Units Within the Kolob Fire Burned Area

Soil Type	Percent of Soil Within Burned Area	Percent Slope	Pre-fire Water Erosion Hazard
Rock land, stony	20	30-70	moderate
Mathis-Rock outcrop complex	18	20-50	severe
Rock outcrop	10	variable	moderate
Clovis-Pastura complex	9	1-10	moderate
Stony colluvial land	9	30-70	moderate
Bond sandy loam	8	1-10	moderate
Clovis fine sandy loam	5	1-5	moderate
Veyo-Pastura complex	5	1-10	slight
Badland, very steep	4	>30	very high
Naplene silt loam	2	2-6	moderate
Cinder land	2	variable	moderate
Magotsu-Pastura complex	2	2-20	moderate
Badland	1	variable	very high
Rock land	1	variable	moderate
Spenlo very fine sandy loam	1	2-10	moderate
Pastura-Esplin complex	1	0-10	moderate
Fluvaquents & Torrifluvents, sandy	<1	variable	severe
Collbran very cobbly clay loam	<1	2-30	moderate
Gravel pits	<1	variable	slight
Gullied land	<1	variable	severe
Palma fine sandy loam	<1	1-5	moderate
Mespun fine sand	<1	0-10	moderate

Below are brief descriptions of the major soil map units that occur in the area of the Kolob fire:

Rock land, stony and Rock outcrop: consists of stony and bouldery soils with sandstone outcrops and cliffs. Stones and boulders are commonly underlain by sand, shale, or siltstone and weathered rock. Soil development is minor due to rock exposure or continual deposits of material from higher lying slopes. Rock outcrops are mostly sandstone, limestone, conglomerate, or basalt.

Mathis-Rock outcrop complex: consists of somewhat excessively drained soils on severely eroded, dissected mountain side slopes of 20 to 50 percent and mesa remnants. Surface soil is typically very stony

loamy fine sand with sandstone bedrock at a depth of about 30 inches. This entire profile is gravelly to very gravelly. Typical vegetation is pinyon-juniper.

Clovis fine sandy loam and Clovis-Pastura complex: occurs mainly on old basalt mesas that are relatively flat with the deeper Clovis soil on gently sloping swales and shallower Pastura soil on ridges and steeper slopes. The effective depth of Pastura soils are limited by a caliche hardpan. Typical vegetation on Clovis soil is sage and on Pastura soil is blackbrush.

Stony colluvial land: consists of unconsolidated colluvial land covered with stones and rock fragments found on the steep lava slopes north of North Creek. Shale or volcanic bedrock is generally at a depth of less than 12 inches. There are a few small areas of shallow soils. Typical vegetation is pinyon-juniper with some shrub species.

Bond sandy loam: consists of shallow, well-drained soils on high, broad mesa tops. Soils formed in residuum weathered from conglomerate and sandstone. Slopes are 1 to 10 percent and typical vegetation is pinyon-juniper.

ZION also contains notable amounts of biological soil crusts where the soil surface is bound together by a community of algae, fungi, lichen, and other microorganisms. This soft crust greatly increases the soils ability to capture and hold water, fix nitrogen from the atmosphere, and resist erosion from wind, raindrop impact and flowing water (Belnap et al. 2001). ZION does not have detailed field surveys to determine the distribution of biological soil crusts. However, these crusts are typically associated with open canopies and sandy soil usually found in pinyon/juniper woodlands and desert shrub communities. Biological crusts are usually killed by hot surface fires, which generally correspond to the moderate to high soil burn severity. The amount of damage and the potential for post-fire recovery of biological crusts depends on the pre-fire vegetation, fire intensity, and fire frequency. One of the biggest threats to the recovery of biological crusts after fire is the potential for cheatgrass invasion (Belnap et al. 2001), which decreases suitable growing surfaces and increases the risk of repeated fire.

Impact Threshold Definitions

Negligible	Soils would not be affected or the effects to soils would be below or at the lower levels of detection. Any effects to soil productivity or fertility would be slight.
Minor	The effects to soils would be detectable. Effects to soil productivity or fertility would be small, as would the area affected. If mitigation were needed to offset adverse effects, it would be relatively simple to implement and likely successful.
Moderate	The effect on soil productivity or fertility would be readily apparent and result in a change to the soil character over a relatively wide area. Mitigation measures would probably be necessary to offset adverse effects and would likely be successful.
Major	The effect on soil productivity or fertility would be readily apparent and would substantially change the character of the soils over a large area in and outside of the park. Mitigation measures to offset adverse effects would be needed and would be extensive; their success could not be guaranteed.
Duration	Short-term - recovers in less than three years
	Long-term - requires more than three years to recover
Area of Analysis	Within and immediately adjacent to the project areas inside the park boundary

Effects of Alternative A – No Action Alternative

Since aerial application of herbicide would not be undertaken in the no action alternative, there would be no direct short-term impacts to soils. Because cheatgrass would likely invade and create a relatively consistent ground cover, the soil erosion would be reduced in the project area in the short-term.

Long-term, the lack of treatment would allow the grass-fire cycle to be perpetuated and overtime the landcover would be altered as woodlands and shrublands would be replaced by invasive grasslands. As cheatgrass invasion would result in increased fire frequency, fire size, and fire intensity, there would eventually be an increase in soil loss from the project area as each fire event would leave exposed soil vulnerable to erosion until plants become re-established. In a cheatgrass dominated landscape, the time period in which soil may be exposed after fire is relatively short, but is likely to correspond with the late summer monsoon thunderstorms that have the most capacity to carry soil away. Top soil would be removed in sheet erosion, and both top soil and subsoil would be transported by rilling and gullying. Soil would be redeposited at the toe of the slope, or more likely, carried into streamchannels with the storm flow. This persistent loss of soil, particularly top soil, would eventually reduce the productivity and soil fertility of the project area. As the grass-fire cycle is known to preclude the recolonization or succession of biological soil crusts, it is likely that the distribution of biological crusts would be reduced and there could be changes in species composition within the crustal communities to favor fire tolerant species or those species that can quickly re-establish after fire.

Cumulative Impacts. Implementation of the no action alternative would mean that aerial herbicide application would not occur and the grass-fire cycle would be perpetuated, which would reduce the effectiveness of other projects: yellow star thistle monitoring and control, sensitive plant monitoring and control of non-native species, stabilization of Cabin Spring, the boundary fence reconstruction, and the Pine Valley Peak prescribed fire. The resulting increase in fires would likely result in wide-spread losses of native vegetation which would expose more soil to erosion. The no action alternative would not impact actions associated with trail reconstruction and clearing or hazard tree removal.

Overall, impacts of no action added to the impacts of other actions affecting soil, would result in long-term, minor to moderate cumulative negative impacts to soils.

Conclusion. Implementation of the no action alternative would result in no short-term impacts to soils, but would result in long-term, minor negative impacts to soils due to increased potential for post-fire erosion and subsequent localized loss of soil productivity and fertility.

Impairment. Because there would be no major, adverse impacts to threatened and endangered plant species or sensitive plant species whose conservation is (1) necessary to fulfill specific purposes identified in the established legislation of Zion; (2) key to the natural or cultural integrity of the park; or (3) identified as a goal in the park's GMP or other relevant NPS planning documents, there would be no impairment to the park's soils by implementation of Alternative A.

Effects of Alternative B – Proposed Action/Preferred Alternative

Herbicide application would have no affect on the soil parent material or soil formation processes. The primary potential for impact is through chemical changes in soil and/or changes in the movement of soil in the landscape.

Based on field dissipation studies, imazapic is moderately persistent in soil with a loss of 50 percent of initial concentration in 7 to 150 days depending upon soil type and climatic conditions (BASF 2006).

Observations of test applications of imazapic in Zion Canyon have shown effective control of annual brome grasses for two growing seasons (Louie et al. 2005), indicating that persistence in this area is near the maximum value.

Glyphosate is a post-emergent broad-spectrum systemic herbicide that has no soil residual activity (Agriliance 2005). It is applied to foliage and is absorbed by leaves and drawn into root tissues. Glyphosate binds tightly to soil particles and is rapidly degraded by soil microbes, minimizing the opportunity for off-site contamination from soil movement.

The mobility of imazapic in soil is limited (BASF 2006) and glyphosate has no mobility in the soil (Agriliance 2005). Soil binding is a complex function of soil pH, texture and organic matter content. The binding of imazapic to soil has been observed to increase with time, while binding of glyphosate is very rapid. Imazapic and glyphosate have been shown to have little lateral movement in the soil. The major route of imazapic and glyphosate loss from the soil is through microbial degradation. Glyphosate generally biodegrades within 21 days and imazapic can remain viable in the soil for up to 3 years. From a total of nine soil dissipation studies conducted with imazapic, no residues were found below the 18-24 inch soil layer. After an application of imazapic, there is little potential for movement off the treated area and the same is true for glyphosate due to the chemical's tight binding nature to soil particles. Imazapic and glyphosate are not volatile and bind moderately to most soil types once applied. Physical movement of the treated soil would be most common way for significant quantities of imazapic or glyphosate to move outside the treatment area.

Since there would be less cheatgrass covering the soil surface, it would be more vulnerable to erosion during the winter. However when winter precipitation is 80 percent of average or above, the emergence of native plants in spring would quickly reduce that vulnerability. Should winter precipitation be very low, as happened in the winter of 2006-2007, native perennial vegetation may not respond and soils would remain vulnerable to erosion through the second summer season. The potential for soil movement during the winter is lessened by the fact that winter precipitation is normally of relatively low intensity with minimal erosive capacity. As such, the increase in short-term erosion rates due to the increased exposure of mineral soil in the winter and early spring that would result from cheatgrass suppression would be negligible to minor, depending on the occurrence of normal winter precipitation and heavy rains the following summer.

It is likely that the period of increased vulnerability to soil erosion would extend into the following summer due to the lack of litter cover that would have been contributed by the cheatgrass. The risk of erosion is moderated by the relatively high infiltration capacity of many of the sandy soils and the presence of abundant coarse fragments armoring the soil surface on steeper slopes. The impact to soils would be negligible to minor and dependent on rainfall patterns.

Long-term, the herbicide treatment would interrupt the grass-fire cycle, which would allow native plant communities to regenerate. This would reduce the frequency of fire-associated soil loss because vegetation dominated by native species has lower fire frequency, intensity and fire size when compared to vegetation communities with cheatgrass as a major component. Maintaining the natural fire regime would result in a moderate improvement in long-term soil productivity and fertility, when compared to the no action alternative.

Cumulative Impacts. The proposed action as well as yellow star thistle monitoring and control, sensitive plant monitoring and control of non-native species, stabilization of Cabin Spring, and the Pine Valley Peak prescribed fire would all maintain native plant communities which in turn help maintain soil productivity and fertility. The replacement of the boundary fence would indirectly help protect soils, particularly biological soil crusts, from impacts caused by illegal off-road vehicles or trespass livestock

grazing. The proposed action would not impact actions associated with trail reconstruction and clearing or hazard tree removal.

Overall, impacts of the actions described under the proposed action added to the impacts of other actions affecting soil, would result in short-term, negligible to minor cumulative negative impacts to soil and long-term, moderate cumulative positive impacts to soil.

Conclusion. The proposed action would result in short-term, minor negative impacts to soil due to decreased soil productivity as a result of herbicide and long-term, moderate positive impacts due to perpetuation of natural fire regimes that decrease the frequency and magnitude of post-fire erosion events.

Impairment. Because there would be no major, adverse impacts to soils whose conservation is (1) necessary to fulfill specific purposes identified in the established legislation of Zion; (2) key to the natural or cultural integrity of the park; or (3) identified as a goal in the park's GMP or other relevant NPS planning documents, there would be no impairment to the park's soils with the implementation of Alternative B.

Water Resources

Affected Environment

Most of the park is characterized by an arid climate. The rainfall generally occurs in two distinct seasons: 1) early winter and spring when storms from the Pacific Ocean move across the intermountain area; and 2) summer when thunderstorms develop from moist air moving northward across the region from Mexico. Based on elevation, nearby climate stations and vegetation, the average annual precipitation in the Dakota Hill project area is similar to the Lava Point RAWS station, which is located approximately 10 miles away at an elevation of 7,700 feet. Based on 10 years of recorded data, Lava Point averages 20.3 inches of precipitation. In the Kolob project area the average annual precipitation is estimated to be 11 inches in the southern portions, increasing with elevation to about 15 inches along the northern and eastern margins. This is based on a weather station located 8 miles east of the project area which is representative of the wetter portions of the Kolob project area.

About 60 percent of the precipitation falls during the winter months (October through April) typically as frontal storm systems that produce rainfall or snow over large areas. About 40 percent of the precipitation falls during the summer monsoon when a southerly air flow brings moist air that produces scattered thunder storms to some degree most days. These sometime produce intense local rainfall and large runoff events. Precipitation is highly variable from year to year, and the summer storms are notably variable from place-to-place. Winter precipitation typically shows a marked increase during "El Niño" events, while the summer monsoon shows little if any response to the El Niño Southern Oscillation. Droughts are common and often occur over several years, while wet years tend to occur as isolated events.

As a result of the weather patterns described above, there are two different flow regimes that occur in the fire area; winter precipitation events that are generally long duration, low intensity storms that produce gradual rises in stream flow, and short-duration, high intensity thunderstorms that can result in rapid rises in stream flow and flash flooding. Soil erosion and floods occur as a result of high-intensity rainfall events, or more rarely from rain-on-snow events. The higher elevation sites tend to hold snow longer and during high snow years can have snow present into May or early June. To understand the frequency and magnitude of these events the National Oceanic and Atmospheric Administration has developed a model of high intensity rainfall events based on the climate records from the park climate station. Table 10 presents the amount of precipitation that has occurred in a given time interval based on how frequently

that magnitude of storm has occurred (or its return interval). For example, a rainfall accumulation of 1.02 inches in one hour has occurred, on average, once every 10 years at the park climate station.

Table 10: Precipitation Frequency Estimates From Park Weather Station (inches)			
Average Return Intervals (years)	**Duration of Storm**		
	15 minutes	**60 minutes**	**6 hours**
1	0.28	0.46	0.79
2	0.36	0.60	0.98
5	0.49	0.82	1.24
10	0.61	1.02	1.46
25	0.80	1.33	1.78
50	0.96	1.60	2.04
100	1.15	1.92	2.34
500	1.72	2.87	3.32
1000	2.03	3.38	3.85
Excerpted from *Precipitation-Frequency Atlas of the United States*, NOAA Atlas 14, Volume 1, Version 3, 2003			

Watersheds and Streamflow. Both project areas drain to the Virgin River. The Dakota Hill area contains the North Fork of the Virgin River and Orderville Canyon on the north, west, and south boundaries of the East fire. These are perennial water sources. Ephemeral drainages on the East fire include Bullock, Esplin, and Walker Gulches plus numerous unnamed drainages. The West fire is bounded by Sleepy Hollow, Telephone Canyon, and Imlay Canyon on the east and Heaps Canyon along the southwest boundary. These canyons are ephemeral in the project area, with small spring-fed perennial streams in their lower reaches.

Within the Kolob project area one perennial stream, North Creek, drains the higher terrain in ZION and flows for about 18 miles to the Virgin River at the town of Virgin, Utah. It crosses the northern part of the project area in a northeast to southwest direction. Two major tributaries of North Creek, the Left Fork and Right Fork join in this project area.

Most creeks and their tributaries in ZION flow within deep canyons that are several hundred to 2,000 feet deep. Many are confined in narrow slot canyons that are confined by bedrock. Where streams are less confined they have built narrow, relatively flat terraces and floodplains in the canyon bottoms that are typically 40 to 100 feet wide and covered with a mixture of upland pinyon-juniper vegetation on the higher terraces and riparian cottonwood-willow vegetation nearer the stream channel. Outside of these terraces, the terrain is dominated by steep slopes covered with rubble from the cliffs above and some areas of exposed rock outcrop. The numerous short steep rocky channels that drain these slopes flow only in immediate response to heavy precipitation.

There is one known spring within the West fire. Cabin Spring (also known as West Rim Spring) discharges along the very edge of Horse Pasture Plateau and has a long history of use by hikers on the West Rim Trail. Cabin Spring flows at approximately 1 gallon per minute. Cabin Spring is along the southeast boundary of the fire and was burned over with high fire intensity and little ground cover remains.

A U.S. Geological Survey (USGS) gauging station (North Fork Virgin River at Springdale, Utah) records continuous flow information on the amount of water draining from the 334 square mile North Fork watershed including the Dakota Hill Complex, which is 14.3 square miles. The burned area is about 4.3 percent of the surface area of the North Fork watershed. Most of the flow in the North Fork of the Virgin

River is contributed by groundwater discharge from the base of the Navajo sandstone, supplemented by spring snowmelt and runoff from individual storm events. Summer base flow in the river varies from 30 cubic feet per second (cfs) in dry years to 60 cfs or more following wet winters. Spring snowmelt can swell flows to 500 to 2,000 cfs over a period of a few weeks. As a result the annual average discharge is 108 cfs.

Orderville Canyon has similar watershed characteristics to the rest of the North Fork drainage though its discharge is much smaller commensurate with its smaller watershed area, about 40 square miles. Summer base flow at the confluence with the North Fork of the Virgin River is 1 to 3 cfs. Flood patterns are expected to be similar to the North Fork of the Virgin River, though reduced in magnitude due to the smaller watershed area. About 25 percent of the Orderville Canyon watershed burned.

Approximately 18 percent of the North Creek watershed within the Kolob project area burned in 2006, and about 11 percent of the watershed is in the project area, with the remaining 7 percent of the burned watershed located outside the park boundary. Within the Kolob project area summer and fall base flow in North Creek is about 3 cfs. Somewhat higher flows in the winter combine with spring runoff and other flood events to raise the average discharge to 5.6 cfs. Spring runoff from snowmelt in the higher headwaters may reach 60 to 100 cfs in wet years, while only about 10 cfs after dry winters.

The other major drainage in the Kolob project area is Coalpits Wash draining the southern half of project south to the Virgin River. Coalpits Wash has a small perennial flow upstream and east of the burn area, but surface flow becomes seasonal by the time it reaches the project area and continuing on to the confluence with the Virgin River downstream from Rockville. During the winter, when evapotranspiration from riparian plants is minimal, stream flow in Coalpits Wash is about 1 cfs. With summer heating surface stream flow dries up entirely. Spring runoff is less significant in Coalpits when compared to North Creek and flows may rise above 10 cfs for only a few days. Two small springs, with a combined flow of less than 2 gallons per minute, discharge from the Shinarump conglomerate near where the large dry tributary meets Coalpits Wash east of Crater Hill.

Even though the Coalpits Wash watershed in the Kolob project area is somewhat less steep and rugged than the North Creek drainage, there remains several hundred feet of relief and the area is incised by many dry channels that have cut into the softer bedrock. Outcrops of Chinle formation form colorful badlands. The south slopes of Cougar Mountain are steep and rubble covered. In the center of the watershed several channels cut into Pleistocene lakebed sediments that were deposited behind the Crater Hill lava dam. South of there, where Coalpits Wash has cut below the basalt and Shinarump conglomerate, it flows through a steep gorge cut into the soft Moenkopi formation. On the west side of this gorge, the steep slopes are covered with basalt talus derived from the Crater Hill basalts.

The slopes of Crater Hill, a cinder cone deposited about 300,000 years ago, are steep but the soil surface is well armored by cinders and infiltration rates are high. Near the base of Crater Hill are some relatively flat benches with deeper soils that are more prone to erosion, and have, in fact, been dissected by several ephemeral channels that have cut to bedrock.

About 40 percent for the watershed of Coalpits Wash burned in the Kolob fire. Almost all of this land is included in the Kolob project area. Two other small portions of the project area drain into other watersheds. About 1 square mile of land west of the Kolob Terrace Road drains into Black Wash then into North Creek. Two small areas totaling about 3.5 square miles drain south and west to Dalton Wash. These are the southwest slopes of Crater Hill and west of Cougar Mountain.

Flash flooding occurs on all channels in both project areas. These are most common with summer monsoon storms, which often produce the largest flood events of the year, but can occur when heavy

precipitation occurs during any season. Based on 70 years of stream gage records on the North Fork of the Virgin River, floods with a return period of 2 years have been about 1,710 cfs, with a return period of 10 years have been about 4,200 cfs, and for a 100 year return period about 9,000 cfs. The largest flood on record occurred in December 1966 with a peak of 9,100 cfs.

Predicted runoff increase from the East fire would be more than 900 percent up to 1,246 cfs. The West fire area does not produce runoff from a 2-year storm in baseline conditions. The post-burn model results for the West fire indicate that runoff would peak at about 164 cfs.

Looking at the larger watershed, the 2-year return period discharge for the North Fork Virgin River USGS gauging station at Springdale is 1,710 cfs. The theoretical, post-fire, 2 year discharge from the East fire is about 70 percent of the amount of the 2-year flow of the North Fork at Springdale. Similarly, the West fire modeled post-fire 2 year discharge is approximate 7 percent of the discharge at Springdale. When comparing the total potential post-fire runoff from both fire areas to a large flood event (100-year discharge) at Springdale, a 14 percent increase in flow is possible.

The magnitude of peak flows following short duration high intensity storms can be expected to increase within and downstream of the Orderville and the North Fork of the Virgin River (the Narrows) Canyons. Prior to the fires flash floods were common occurrences following high intensity and short duration storms in the impacted canyons. In spite of the greater peak flows and larger quantities of woody debris during flash floods, the dangers to visitors and staff remain inherently the same.

Extrapolating these observations to North Creek, a very large flood event would be about 6,000 to 7,000 cfs. A similar estimate of a large flood event in Coalpits Wash would be 4,000 to 5,000 cfs. It is important to note that these figures are long-term averages and generally for unburned watersheds. When vegetation and soil cover are removed by fire the discharge for flood events is generally elevated for 3-6 years following the fire.

Water Quality. Water quality conditions in ZION do not vary dramatically from source to source, though individual streams may vary considerably over time particularly in turbidity and suspended sediment. Springs from the base of the Navajo sandstone are moderately low in dissolved solids (specific conductance near 300 µmhos/cm), while streams draining from higher or lower strata have higher concentrations. Of the major rivers in the park, LaVerkin Creek and North Creek have the highest levels of mineralization (specific conductance near 1000 µmhos/cm), while the North and East Forks of the Virgin River show somewhat lower levels (specific conductance or 600-800 µmhos/cm). There have been rare occurrences of dissolved metals in excess of drinking water standards, which appear to be anomalies rather than identifiable problem areas.

According to Standards of Quality for Waters of the State, R317-2, Utah Administrative Code, waters in the North Fork of the Virgin River and North Creek are protected for domestic water supply (category 1C), secondary contact recreation (category 2B), cold water species of game fish and other cold water aquatic life and necessary aquatic organisms in their food chain (category 3A), and agricultural uses (category 4). The numeric values associated with these protected uses are the standards referred to in the following description of water quality.

The North Fork of the Virgin River and North Creek are monitored for water quality by the Utah Division of Water Quality (UDWQ) and the NPS Northern Colorado Plateau Network (NCPN) respectively. Two sites are located on the North Fork. The NCPN began monitoring at the North Fork Road crossing (STORET Site Number 4951260) just upstream of the park and project area in 2005, while UDWQ has monitored upstream of the confluence with the East Fork of the Virgin River (STORET Site Number 4950950) for several years.

The waters in the North Fork of the Virgin River are dominated by sodium, calcium, magnesium and bicarbonate ions. Concentrations of total dissolved solids (TDS) are typically about 360 mg/l. Parameters found to most frequently exceed water quality standards are fecal indicator bacteria, often associated with flood events, and total phosphorus. The fact that algal growth problems are not observed in spite of relatively high phosphorus levels (a condition common on the Colorado Plateau) indicates that aquatic plants are nitrogen limited in these rivers. A flush of algal growth can be expected when nitrates are flushed from the burned areas, with associated increases in the daily fluctuation of dissolved oxygen and pH.

Monthly water quality monitoring began on North Creek in the fall of 2005 (STORET Site Number 4950920). Field data is collected for discharge, water and air temperature, turbidity, specific conductance, dissolved oxygen and pH. Water samples are collected and analyzed for major ions, metals and nutrients. Measurements in the months following the Kolob fire found water quality criteria exceeded water quality standards for pH and dissolved oxygen. The increase in pH may have been due to ash influx due to overland flow during storms while the increase in dissolved oxygen resulted from dense algal growth responding to a flush of nutrients. Due to the synoptic nature of sampling on North Creek no subsequent crash in dissolved oxygen was observed. However, 3 months after the fire dissolved oxygen levels were back to normal.

In addition, UDWQ monitors North Creek well downstream of the park. Waters here are dominated by calcium, magnesium and sulfate ions with an average pH of 8.2 and an average TDS concentration of 1,150 mg/l. Agricultural water quality standards (1,200 mg/l) have frequently been exceeded. A state investigation of this problem concluded that the source of the dissolved solids was probably a combination of natural sources (primarily Moenkopi formation downstream of the park) and irrigation return flows.

Little is known of water quality in Coalpits Wash. A single measurement found the TDS concentration to be 1,520 mg/l. The small spring adjacent to Coalpits Wash east of Crater Hill had a TDS of 6,800 mg/l. There are no human induced sources of contamination in Coalpits Wash watershed beyond recreational campers.

Episodic declines in water quality are most likely to persist until the vegetative cover reestablishes on the burned area. This would be most notable to visitors during and following runoff events. As the vegetation recovers the impacts to water quality would decline.

Sediment Yield. Streams draining from ZION are prodigious producers of sediment due to the phenomenal rate of canyon cutting that is occurring. Using estimates of sediment yields developed for the North Fork of the Virgin River (800,000 to 1,000,000 tons of sediment per year) the smaller watershed of North Creek is estimated to yield on average 250,000 to 300,000 tons per year. Coalpits Wash is estimated to yield 50,000 to 80,000 tons per year. The vast majority of this sediment moves during flood events, so there is a high degree of variability from day-to-day and year-to-year depending on the number, magnitude and duration of flood events. The predominant size class of sediment in the Virgin River Basin is sand due to the abundance of eroding sandstone. Steeper channels will move more large sediment particles up to boulder size.

An exceptional type of sediment laden flow called a “debris flow” occurs in the steepest intermittent tributary channels. A debris flow occurs when a flood gains sufficient sediment, typically from a slope failure, so that it flows as a thick slurry with a consistency of wet concrete. While relatively slow moving, debris flows carry a large amount of energy and are capable of considerable damage when they encounter man-made structures. Debris flows from these steep channels typically loose energy and drop their

sediment when they encounter the more gradual slopes of the larger channels of North Creek, Coalpits Wash, and the Virgin River.

Wetlands. Within the Dakota Hill project area known springs with wetlands include Cabin Spring, less than 1 acre, and an unnamed spring north east along the rim from Cabin Spring. There are no wetlands in the east portion of the Dakota Hill Complex.

Wetlands in the Kolob project area occur as narrow strips along perennial and seasonal streams and at a few spring discharges. Specifically, riparian wetlands occur along the Left and Right Forks of North Creek, North Creek proper, and Trail Canyon. In this area they are indicated by a Fremont cottonwood tree canopy with components of velvet ash, Goodings willow and box elder. Understory vegetation includes coyote willow, seep willow, sedges (*Carex* spp.), horsetail (*Equisetum* spp.), cattail, bullrush (*Juncus* spp.), and grasses. Since inundation is only occasional, several upland plant species are also found. This vegetation type is mapped in the National Wetland Inventory (NWI) (USFWS 2000) as Rp1FO6 (riparian, flowing water, forested, deciduous (cottonwood)). The actual extent of these linear wetlands is relatively small, totaling about 70 acres in the Kolob fire area. Under natural conditions fires are rare in these wetlands, which are not generally adapted to fire. Where human activity has introduced fire or non-native plants that promote fire have invaded, the result can be an increase in mortality among trees of all age classes. Plants that grow in the wettest areas and have growing points below ground (such as horsetail, sedge, bullrush, and willow) will often survive fire and sprout vigorously. Immediately after the 2006 Kolob fire, it was noted that about 50 percent of riparian trees had been killed. There has been some recovery of riparian trees in the Kolob area this past growing season.

Within the Kolob project area the largest wetland spring is at Grapevine Spring located adjacent to the Left Fork of North Creek at the northern margin of the project area. It is mapped at about 7 acres of Rp1FO6 (riparian, flowing water, forested, deciduous (cottonwood)) wetland. This spring has been the subject of several studies and is an example of a very diverse wetland. The other spring wetlands are located along steep tributaries of Trail Canyon north and east of Cougar Mountain. They originate with spring discharges at the base of the Navajo Sandstone and extend as very narrow corridors down to the bottom of Trail Canyon. They are not identified in the NWI, but are mapped as Fremont Cottonwood – Velvet Ash complex in the Zion National Park Vegetation Maps.

NPS Director's Order 77-1 provides guidelines for the protection of wetlands within NPS units. It states a policy of no net loss of wetlands and provides a process for evaluating actions that have a potential to have adverse effects on wetlands. When proposed actions have an adverse impact on wetlands, a Wetlands Statement of Findings is required to describe why the action is necessary and how impacts to wetlands are to be mitigated. In this project a Statement of Findings is not needed because wetlands would specifically be avoided by designating no-spray areas and buffer strips along all perennial and seasonal streams and springs.

Impact Threshold Definitions

Negligible	Water quality, hydrology, and wetlands would not be affected, or changes would be either non-detectable or, if detected, would have effects that would be considered slight and local.
Minor	Changes in water quality, hydrology, and wetlands would be measurable, although the changes would be small and the effects would be localized. No mitigation measure associated with water quality or hydrology would be necessary.
Moderate	Changes in water quality, hydrology, and wetlands would be measurable, but would be relatively local. Mitigation measures associated with water quality or hydrology would be necessary and the measures would likely succeed.
Major	Changes in water quality, hydrology, and wetlands would be readily measurable, would have substantial consequences, and would be noticed on a regional scale. Mitigation measures would be necessary and their success would not be guaranteed.
Duration	Short-term – would occur within the first year following treatment
	Long-term – would continue more than one year following treatment
Area of Analysis	Within and immediately adjacent to the project areas inside the park boundary and the downstream drainages

Effects of Alternative A – No Action Alternative

Since aerial application of herbicide would not be undertaken in the no action alternative, there would be no potential for herbicide to enter surface or ground water.

Long-term, the lack of treatment would allow the grass-fire cycle to be perpetuated and overtime the land cover would be altered as woodlands and shrublands would be replaced by invasive grasslands. A complete conversion to shallow rooted grasses would likely increase the amount of groundwater recharge that would occur in the project area. In the Dakota Hill Complex this would increase recharge to the Navajo aquifer, however given the small percentage of the overall watershed burned, and the natural variation year-to-year variation in recharge and stream flow, it is doubtful that this change would be measurable at the Springdale gage. The effect of this on stream flow in the Kolob fire is uncertain and likely negligible since the geologic strata of the project area are almost entirely below the Navajo sandstone, the major groundwater aquifer, and contribute very little to overall stream flow. The period during which there is a short-term increase in flood peaks following fires would be shortened by the rapid growth of cheatgrass, however these periods would be more frequent. Although given the shallow rooting structure of cheatgrass, soils would become increasingly vulnerable to erosional processes especially on steeper slopes. Stream water quality would experience short-term increases in sediment loading, nutrients, ash and pH with each major fire typically lasting 1 to 2 years.

Frequent fire would likely reduce the fire intolerant riparian vegetation along stream channels in the Kolob fire, resulting in a moderate increase in water temperature, and minor alterations of stream channel morphology, water chemistry, and wetland functions. Also, more frequent fires would result in increases in turbidity, sediment and ash transport from hillslopes to channels, as well as the loss of sediment retention and filtration functions that would have been performed by the riparian buffers along streams. Given the already very high level of erosion and sediment transport from the landscape, the magnitude of impacts from an increased fire frequency due to the increased presence of cheatgrass is minor.

Cumulative Effects. Implementation of the no action alternative would mean that aerial herbicide application would not occur and the grass-fire cycle would be perpetuated, which would reduce the effectiveness of other projects: yellow star thistle monitoring and control, sensitive plant monitoring and control of non-native species, stabilization of Cabin Spring, and the Pine Valley Peak prescribed burn. The resulting increase in fires would likely result in wide-spread losses of native vegetation cover; which could increase erosion that could affect surface waters.

The no action alternative would not have any impact on actions associated with emergency stabilization after the Dakota Hill fire including the boundary fence reconstruction, trail reconstruction and clearing, and hazard tree removal. The no action alternative does not have any relationship to or would affect the rehabilitation of the lower West Rim Trail.

Overall, impacts of no action added to the impacts of other actions affecting water resources, would result in long-term, moderate cumulative negative impacts to water resources.

Conclusion. Implementation of the no action alternative would result in no short-term impacts to water resources, but would result in long-term, minor to moderate negative impacts to water resources due to increased potential for post-fire erosion and subsequent alteration of sediment yield, water quality, and stream morphology.

Impairment. Because there would be no major, adverse impacts to water resources whose conservation is (1) necessary to fulfill specific purposes identified in the established legislation of Zion; (2) key to the natural or cultural integrity of the park; or (3) identified as a goal in the park's GMP or other relevant NPS planning documents, there would be no impairment to the park's water resources by the implementation of Alternative A.

Effects of Alternative B – Proposed Action/Preferred Alternative

There are two primary pathways for herbicide to enter water resources. First, is direct application of herbicide during treatment and second is transport of soil containing herbicide into water resources.

The proposed action includes no-spray areas along all perennial and seasonal flow channels, springs, and wetlands that are likely to have water at or near the surface. This would make the potential for any herbicide to get into the water very unlikely. All such features would be buffered by 300 feet on either side to assure that there would be essentially no opportunity for spray, directly or in drift, to enter those waters. Additionally, the application equipment (boom, nozzles, droplet size, etc.) and technique (elevation, air speed, direction of travel) would be designed to reduce drift. With the mitigation measures identified the expected width of the transition zone between fully sprayed and no-spray along the direction of travel would be 20-40 feet. The no-spray areas would be loaded into an on-board computer system that would allow the pilot to accurately navigate around those features.

Application of this no-spray buffer in the field has proven to be practical on the Kolob fire. It would be easier to apply on the Dakota Hill Complex where the separation between burned area and streams is much greater than 300 feet and there are obvious slickrock outcrops along the plateau margins.

In consideration of the possible movement of herbicide from sprayed soil into streams, both the persistence of the chemical in the soil and sediment transport within the system are examined. While winter precipitation is greater, it is generally of low intensity and therefore rarely results in large scale mobilization and transport of the soil surface. Since the herbicide application would probably take place in the fall, the first time that sediment transport is likely to occur in the treated watersheds would be in the summer following treatment with the onset of the summer monsoon season and its intense thunderstorms. Imazapic loses 50 percent of initial concentration in 7 to 150 days depending upon soil type and climatic conditions as a result of plant uptake and microbial degradation (BASF 2006). Using a maximum reported persistence of 150 days to lose 50 percent of initial concentration, and carrying out that loss over time, only about 30 percent of the initial concentration would still be present in the soil in July, the rest would have been lost through plant uptake or microbial degradation. Imazapic has limited mobility in soil due to soil binding, which increases with time (BASF 2006), so it is progressively less likely to leach out

of the soil into surface water. The preservation of the riparian corridors in the stream buffers would capture some of the contaminated soil before it enters the stream channels, but some amount would potentially be transported into stream channels. Once soil containing herbicide enters stream channels, much would remain with the soil particles and would eventually be re-deposited as soil within the floodplain. The concentration of any herbicide that did go into solution would be very low due to the limited mobility of the herbicide and the large volume of water and sediment moving through the system during such run-off events.

Furthermore, imazapic is reported to rapidly photo degraded by sunlight with a half-life in water of less than 8 hours (BASF 2006), so any herbicide that would go into solution would be very short lived. Because imazapic binds to soil and dissipation studies have not found any chemical residues below 18-24 inch soil layer, it is highly unlikely that imazapic would get into groundwater.

The other active herbicide glyphosate is generally not active in the soil and persists for 1-3 weeks forming a strong bound with soil particles, thus the potential for leaching into groundwater and flowing into surface water is low. So there is little to no chance for chemicals to get into drinking water.

Long-term, the herbicide treatment would interrupt the grass-fire cycle, which would allow native plant communities to regenerate. This would reduce the watershed impacts of burned lands (increased surface flows, erosion, ash flows, and nutrient flushes) that result from increased fire frequency, fire size, and fire intensity. The wetlands and riparian vegetation would not be removed by fire and would continue to provide a host of ecological benefits.

Cumulative Effects. The proposed action as well as yellow star thistle monitoring and control, sensitive plant monitoring and control of non-native species, stabilization of Cabin Spring, and the Pine Valley Peak prescribed fire would all maintain native plant communities which in turn help maintain watershed characteristics including stream flow, sediment transport, water quality, and wetlands. The replacement of the boundary fence would indirectly help protect stream channels from impacts caused by illegal off-road vehicles or trespass livestock grazing. The proposed action would not impact actions associated with trail reconstruction and clearing or hazard tree removal.

Overall, impacts of the actions described under the proposed action added to the impacts of other actions affecting water resources, would result in short-term, minor cumulative negative impacts to water resources and long-term, moderate cumulative positive impacts to water resources.

Conclusion. The proposed action would result in short-term, negligible to minor negative impacts to water resources, and long-term, moderate positive impacts to water resources due to perpetuation of natural fire regimes that decrease the frequency and magnitude of post-fire watershed responses.

Impairment. Because there would be no major, adverse impacts to water resources whose conservation is (1) necessary to fulfill specific purposes identified in the established legislation of Zion; (2) key to the natural or cultural integrity of the park; or (3) identified as a goal in the park's GMP or other relevant NPS planning documents, there would be no impairment to the park's water resources by the implementation of Alternative B.

Natural Soundscapes

Affected Environment

Natural soundscapes are comprised of the natural sound conditions that exist in the absence of any human-produced noises. These conditions are actually composed of many natural sounds, near and far, which often are heard as a composite, not individually. Natural sound conditions include the sounds of running water, blowing wind, chirping birds, and many other sounds found in nature. The opportunity to experience ZION's natural soundscape unimpaired by the sounds of human civilization is an important part of the overall visitor experience, especially as it contributes to the solitude and wilderness experience that is integral to much of the park.

Acoustic data has been collected in ZION over the years. The most recent and most comprehensive data collection effort was by Wyle Laboratories (Hobbs and Downing 2003), which collected acoustic data from October 2000 to November 2001 at 13 sites throughout the park. The North Creek site is within the area burned by the 2006 Kolob fire. There were no data collections sites within the Dakota Hill Complex, although the Scout Lookout, Lava Point, and East Rim sites are near the areas burned. The data was collected during spring, summer, and fall at 12 sites and during all four seasons at one site. The data suggests that ZION is a quiet soundscape. Little variation in the soundscape was observed across the park, during the day, and throughout the year. The recorded ambient noise level in the park in backcountry settings is approximately 20 A-weighted decibels (dBA), which is the noise level equivalent to a quiet house at midnight. The recorded ambient noise level in the park in frontcountry settings is approximately 40 dBA.

Human-generated noise in the park is predominantly from vehicle traffic, aircraft overflights, and maintenance and administrative activities. Frontcountry areas, such as near roads, often have higher levels of noise. Mechanical noises, such as those produced by aircraft, can drown out these natural sounds on a temporary basis.

Impact Threshold Definitions

Negligible	Frontcountry Low Development – Noise created by human activities associated with the alternative may be present during the daylight hours, but would rarely be audible between sunset and sunrise.
	Primitive and Pristine – Natural sounds predominate. Noise created by human activities associated with the alternative is rarely audible. When noise is present, it is at low levels and occurs for only short durations in a small geographic area. Visitors almost always have the opportunity to experience the natural soundscape free from noise.
Minor	Frontcountry Low Development – Noise created by human activities associated with the alternative may predominate during the daylight hours, but the majority of the time the noise is at low levels, and is only rarely at greater than medium levels. Noise created by human activities associated with the alternative is rarely audible between sunset and sunrise.
	Primitive and Pristine – Natural sounds usually predominate. Noise created by human activities associated with the alternative is infrequent, and occurs for only short durations in most of the area. Visitors almost always have the opportunity to experience the natural soundscape free from noise created by human activities associated with the alternative most of the time in the majority of the area.
Moderate	Frontcountry Low Development – Noise created by human activities associated with the alternative predominates during the daylight hours, but only at medium or lower levels a majority of the time. Localized areas may experience noise at medium to high levels half of the daylight hours. Noise created by human activities associated with the alternative is occasionally audible between sunset and sunrise.
	Primitive and Pristine – Noise created by human activities associated with the alternative is present infrequently too occasionally, at low to medium levels and durations. Portions of these zones within 0.5-mile of the Frontcountry Low Development Zone often experience noise at low or medium levels and durations. Noise created by human activities associated with the alternative is occasionally audible between sunset and sunrise.
Major	Frontcountry Low Development – Noise created by human activities associated with the alternative predominates during daylight hours, and is at greater than medium levels a majority of the time that noise is present. Large areas may experience noise at medium to high levels during the majority of the daylight hours. This noise is often audible between sunset and sunrise.
	Primitive and Pristine – Natural sounds are commonly masked by noise created by human activities associated with the alternative at low or greater levels for extended periods of time. Portions of the zones within 0.5-mile of the Frontcountry Low Development Zone often experience noise at medium levels and durations, and noise levels in these areas occasionally are high. Noise created by human activities associated with the alternative is frequently audible between sunset and sunrise.
Duration	Short-term – effects extend only through the duration of the proposed project
	Long-term – effects extend beyond the period of the proposed project
Area of Analysis	Within and immediately adjacent to the project areas inside the park boundary

Effects of Alternative A – No Action Alternative

Since aerial application of herbicide would not be undertaken in the no action alternative, there would be no short-term increase in mechanical noise generated by treatment activities, such as the helicopter operating in the each of the project areas for 2 weeks each and the occasional sounds of pumps and equipment needed to fill and service the aircraft at the helibase and helispot.

Long-term, the lack of treatment would allow the grass-fire cycle to be perpetuated and overtime there would be an increase in fires and fire suppression activities. Fire suppression activities generate noise due to the use of mechanical equipment, such as helicopters, pumps, and chainsaws. Noise levels for these pieces of equipment vary by model and modification, but for reference chainsaws generate 125dBA and

helicopters operating 200 feet above the ground generate 99 dBA. This fire suppression equipment would be used for short durations and in local areas so sound would dissipate quickly and variations in vegetation and topography would also minimize sound impacts with distance. However, the use of fire suppression equipment in the project area is expected to increase with the increased fire frequency, fire size, and fire intensity, so such noise intrusions would become increasingly common during the summer months. Also, fires burning in continuous fuels created by cheatgrass are notoriously difficult to control so firefighting resources are likely to be more numerous and effective fire control would be more reliant upon heavy equipment and aerial suppression tactics.

Cumulative Effects. Implementation of the no action alternative would mean that aerial herbicide application would not occur and the grass-fire cycle would be perpetuated, which would reduce the effectiveness of other projects: yellow star thistle monitoring and control, sensitive plant monitoring and control of non-native species, and stabilization of Cabin Spring. There would be no additive noise effect to the Pine Valley Peak prescribed fire.

Because helicopters would be used for the boundary fence reconstruction and the West Rim Trail work, there would be minor short-term, cumulative impacts to soundscapes. There are no long-term cumulative impacts to soundscapes.

Conclusion. Implementation of the no action alternative would result in no short-term impacts to soundscapes, but would result in long-term, negligible negative impacts to soundscapes due to noise from increased fire suppression activity.

Impairment. Because there would be no major, adverse impacts to natural soundscapes whose conservation is (1) necessary to fulfill specific purposes identified in the established legislation of Zion; (2) key to the natural or cultural integrity of the park; or (3) identified as a goal in the park's GMP or other relevant NPS planning documents, there would be no impairment to the park's natural soundscapes from the implementation of Alternative A.

Effects of Alternative B – Proposed Action/Preferred Alternative

Under this alternative, a helicopter would be working for approximately 2 weeks in each of the project areas (Dakota & Kolob) to complete the initial herbicide application. All helicopter work would take place during daylight hours. The helicopter would generally be flying about 200 feet above the ground, depending on the terrain and target, so the noise generated would be about 99 dBA. This increase in noise is five times what the ambient noise is in the backcountry settings of the project area and about double what the ambient noise is in the frontcountry settings like the Kolob Terrace Road. The noise would be loudest closest to the helicopter and would diminish with distance. As the area actively being treated would be closed to the public during treatment, it is unlikely that people other than those working on the project would experience the maximum noise level.

The helibase near Coalpits Wash and helispot at Lava Point would experience the most frequent noise and the most variation in noise levels due to the re-filling and servicing of the helicopter that would take place at those locations. Each helicopter landing and take-off would temporarily increase noise at those locations. These areas would also experience localized, short-term noise generated by the intermittent use of the fuel pump used to dispense fuel into the helicopter as well as the mechanical agitator and pump used to mix the herbicide and fill the tank of the helicopter. Generators may be used to power the pumps, but it is most likely that the contractor would have a self-contained fuel truck and mix truck that would handle all mechanical needs associated with the operation. The treatment areas would be closed to visitor use during the project. So there would be no effect to visitors from noise generated by the helicopter operations. Some of the noise at the Coalpits helibase would be noticeable from Highway 9 corridor, but

would likely be low key due to the distance from the highway and the fact that the terrain. The helibase is approximately 100 yards north of Highway 9, behind a large earthen berm. The Coalpits Trailhead near the helibase would be closed to use during operations, so the soundscape experience of visitors would not be impacted.

Long-term, the herbicide application would interrupt the grass-fire cycle so fires would be less frequent than if no action were taken. Fewer fires would require fewer fire suppression operations and less noise would be generated. Furthermore, any fires that would start after successful herbicide treatment would likely be smaller and more easily handled with minimum impact suppression tactics which usually generate less noise than other firefighting tactics.

Cumulative Effects. The proposed action as well as the boundary fence reconstruction and the West Rim Trail work would all use helicopters that would increase ambient noise in different areas of the park during daylight hours. Road corridors in the project areas are zoned as Frontcountry Low Development and the remaining lands are generally zoned as either Primitive or Pristine.

Overall, impacts of the actions described under the proposed action added to the impacts of other actions affecting soundscapes, would result in short-term, negligible cumulative negative impacts to soundscapes in frontcountry settings during daylight hours and short-term, moderate cumulative negative impacts to soundscapes in primitive or pristine settings during daylight hours.

Conclusion. The proposed action would result in short-term, negligible negative impacts to soundscapes in frontcountry settings during daylight hours and short-term, moderate negative impacts to soundscapes in primitive or pristine settings during daylight hours as a result of helicopter noise. There would be long-term minor positive impacts to soundscapes due to restoration of natural fire regimes and reduced frequency of noise generated by fire suppression activities.

Impairment. Because there would be no major, adverse impacts to natural soundscapes whose conservation is (1) necessary to fulfill specific purposes identified in the established legislation of Zion; (2) key to the natural or cultural integrity of the park; or (3) identified as a goal in the park's GMP or other relevant NPS planning documents, there would be no impairment to the park's natural soundscapes from the implementation of Alternative B.

Wilderness

Affected Environment

In 1974, approximately 131,000 acres of ZION were recommended to Congress for formal wilderness designation. All of the area within the Dakota Hill Complex and most of the area burned in the Kolob fire are within recommended wilderness (Figures 4A & 4B). Not all of the burned areas are proposed for treatment. In the Dakota Hill Complex fire about 3,161 acres are proposed for treatment, all of which are within recommended wilderness. In the Kolob fire about 6,739 acres are proposed for re-treatment, and of those about 6,283 acres are within recommended wilderness. While not yet legislatively designated, this recommended wilderness is managed as wilderness in accordance with NPS *Management Polices* (NPS 2006b). These areas provide visitors an opportunity to experience ZION's natural soundscape unimpaired by the sounds of human civilization.

The 1964 Wilderness Act defined wilderness as "an area where the earth and its community of life are untrammeled by man." In addition, the act states that "except as necessary to meet the minimum requirements for the administration of the area for the purposes of this act, there shall be no temporary

road, no use of motor vehicles, motorized equipment or motorboats, no landing of aircraft, no other form of mechanical transport, and any structure or installation within any such area."

In this environmental assessment, wilderness includes both the biophysical resources of wilderness as well as wilderness character, which can be thought of as the human experience of wilderness. Two commonly used terms to describe wilderness resources and character are naturalness and wildness. While the two terms are similar, they each describe a different value of wilderness. Naturalness encompasses the ecosystem components and processes that belong in the wilderness, such as native plant communities and native wildlife species. Wildness encompasses the lack of direct human control, such as vast roadless landscapes and free-flowing rivers. Some things are both natural and wild (i.e., a bear wandering through a mountain meadow) while others are either natural or wild (i.e., flood that results from a ruptured dam is wild but not natural; while the release of a captive bred condor is natural but not wild).

Impact Threshold Definitions

Negligible	A change in the wilderness character could occur, but it would be so small that it would not be of any measurable or perceptible consequence.
Minor	A change in the wilderness character and associated values would occur, but it would be small and, if measurable, would be highly localized.
Moderate	A change in the wilderness character and associated values would occur. It would be measurable but localized.
Major	A noticeable change in the wilderness character and associated values would occur. It would be measurable and would have a substantial or possibly permanent consequence.
Duration	Short-term – effects would extend only through the duration of the proposed project
	Long-term – effects would extend beyond the period of the proposed project
Area of Analysis	Within and immediately adjacent to the project areas inside the park boundary

Effects of Alternative A – No Action Alternative

Under this alternative, aerial herbicide application would not occur so there would be no use of aircraft over wilderness and a foreign substance, herbicide, would not be broadcast into the ecosystem. In this way, wildness would not be directly impacted. The visitor experience of a wild landscape free from human intervention would not be impacted.

However, without the aerial application of herbicide, the grass-fire cycle would continue uninterrupted. As described in the vegetation section of this document, non-native cheatgrass could come to dominate the project area and spread into the surrounding areas, including the more remote interior areas of the park. Fueled by the cheatgrass, fire frequency, fire size, and fire intensity would increase. Both cheatgrass and the fires fueled by cheatgrass are unnatural in the ZION wilderness. Overtime, natural components of the wilderness, such as native vegetation communities and the native wildlife species they provide habitat for, could be reduced due to the continuation of the grass-fire cycle. This could result in long-term impacts to naturalness. Furthermore, the increase in fire frequency, fire size, and fire intensity as well as the resulting fire suppression activities could negatively impact the visitor experience of wilderness with increasing regularity.

Figure 4A

back

Figure 4B

back

Cumulative Effects. Implementation of the no action alternative would mean that aerial herbicide application would not occur and the grass-fire cycle would be perpetuated, which would reduce the effectiveness of other projects: yellow star thistle monitoring and control, sensitive plant monitoring and control of non-native species, and stabilization of Cabin Spring. The increased flammability of the landscape would result in loss of native plant communities and wildlife habitat would reduce the naturalness of the wilderness. It would also result in more fire suppression efforts due to increased fire frequency, which would temporarily reduce the wildness of the wilderness.

Other actions such as the boundary fence reconstruction, West Rim Trail work, and the Pine Valley Peak prescribed fire all occur within recommended wilderness. While these projects are occurring there would be short-term negative minor to moderate effects to solitude and the "wild" feeling of the area, especially during helicopter use on the boundary fence and the West Rim Trail.

Overall, impacts of no action added to the impacts of other actions affecting wilderness, would result in short-term negative minor to moderate impacts to wilderness and long-term, moderate cumulative negative impacts to wilderness.

Conclusion. Implementation of the no action alternative would result in no short-term impacts to wilderness, but would result in long-term, moderate negative impacts to wilderness due to loss of naturalness resulting from increased fire suppression activity as well as the loss of native plant communities and wildlife habitat.

Impairment. Because there would be no major, adverse impacts to wilderness whose conservation is (1) necessary to fulfill specific purposes identified in the established legislation of Zion; (2) key to the natural or cultural integrity of the park; or (3) identified as a goal in the park's GMP or other relevant NPS planning documents, there would be no impairment to the park's wilderness from the implementation of Alternative A.

Effects of Alternative B – Proposed Action/Preferred Alternative

All activities affecting wilderness must be considered under the minimum requirement concept. This concept is a documented process used to determine if administrative activities affecting wilderness resources or the visitor experience are necessary and how to minimize impacts. The park Wilderness Committee met to review the proposed action. The Committee determined through the minimum requirement analysis process that the action could be completed within the recommended wilderness area without long-term impairment of wilderness character and that the use of a helicopter to apply the herbicide was the minimum tool to use to produce the long-term benefits of the proposed action.

Under this alternative, a helicopter would be working for approximately 2 weeks to treat the Dakota east and west fires and an additional 2 weeks to re-treat the Kolob fire project area. All helicopter work would take place during daylight hours. There would be temporary visitor use restrictions in various sections of the project area to assure that there are no visitors where herbicide is actively being applied. Short-term, such restrictions would greatly reduce the sense of wildness and freedom for which wilderness is sought by visitors. Furthermore, areas adjacent to the closures would still be open to visitor use but the sight and sound of the helicopter would be apparent to visitors using those areas and would diminish their sense of wildness. Long-term, visitors who know that the area had been treated with herbicide might feel that the land was less wild and value their experience less.

Long-term, the herbicide treatment would interrupt the grass-fire cycle, which would allow native plant communities to regenerate and provide habitat for native wildlife. As the native plant communities and the native wildlife species as well as the related ecosystem processes (e.g., nutrient cycling) are all natural

features of the wilderness, their perpetuation would serve to preserve the naturalness of the wilderness. Furthermore, interruption of the grass-fire cycle would restore natural fire regimes, characterized by infrequent and small fires. The restoration of natural fire regimes would enhance naturalness of the wilderness.

Cumulative Effects. The proposed action, the West Rim Trail restoration, and the boundary fence reconstruction all propose to use helicopters in or near recommended wilderness. Helicopter use would increase ambient noise in these areas of the park during daylight hours. Such noise would be noticeable in some wilderness areas and would negatively impact the wilderness experience of some users in those surrounding areas. Long-term, the proposed action as well as the yellow star thistle monitoring and control, sensitive plant monitoring and control of non-native species, stabilization of Cabin Spring, and the Pine Valley Peak prescribed fire would all maintain native plant communities and wildlife habitat, thus enhancing the naturalness of the wilderness in the project area. The replacement of the boundary fence would indirectly help protect wilderness character and solitude by preventing access of illegal off-road vehicles or trespass livestock grazing.

Overall, impacts of the actions described under the proposed action added to the impacts of other actions affecting wilderness, would result in short-term, moderate cumulative negative impacts to wilderness and long-term, moderate cumulative positive impacts to wilderness.

Conclusion. The proposed action would result in short-term, moderate negative impacts to wilderness due to the introduction of herbicide and the intrusion of the helicopter in wilderness. There would be long-term, moderate positive impacts to wilderness due to perpetuation of native plant communities, wildlife habitats, and natural fire regimes.

Impairment. Because there would be no major, adverse impacts to wilderness whose conservation is (1) necessary to fulfill specific purposes identified in the established legislation of Zion; (2) key to the natural or cultural integrity of the park; or (3) identified as a goal in the park's GMP or other relevant NPS planning documents, there would be no impairment to the park's wilderness from the implementation of Alternative B.

Public Health and Safety

Affected Environment

The health and safety of visitors, park staff, and adjacent property owners are of the utmost importance to ZION and the NPS. The park has identified two primary concerns related to health and safety from the proposal to use aerial application of herbicide to restore native plant communities. The first concerns hazards directly related to the helicopter and herbicide application operations that could affect the public, contractors, and agency personnel involved in the treatment. The second concerns hazards posed by the result of undertaking the treatment or not undertaking the treatment, and include the fate of herbicides in the environment and the impacts of treatment or non-treatment on future fire frequency and intensity.

Impact Threshold Definitions

Negligible	Public health and safety would not be affected, or the effects would be at low levels of detection and would not have an appreciable effect on the public health or safety.
Minor	The effect would be detectable, but would not have an appreciable effect on public health and safety. If mitigation was needed, it would be relatively simple and likely successful.
Moderate	The effects would be readily apparent and would result in substantial, noticeable effects to public health and safety on a local scale. Mitigation measures would probably be necessary and would likely be successful.
Major	The effects would be readily apparent and would result in substantial, noticeable effects to public health and safety on a regional scale. Extensive mitigation measures would be needed, and their success would not be guaranteed.
Duration	Short-term - effects lasting for the duration of the treatment action
	Long-term - effects lasting longer than the duration of the treatment action
Area of Analysis	Park and surrounding communities

Effects of Alternative A – No Action Alternative

Under this alternative, aerial herbicide application would not occur so there would be no potential for impacts to human health and safety due to helicopter operations or herbicide in the environment.

However, without the aerial application of herbicide, the grass-fire cycle would continue uninterrupted. As described in the vegetation section of this document, non-native cheatgrass could eventually come to dominate the project area and spread into the surrounding areas, including the more remote interior areas of the park. Fueled by the cheatgrass, fire frequency, fire size, and fire intensity could increase. Fires fueled by cheatgrass are more difficult to suppress due to long flame lengths and rapid rates of spread (BASF 2003a). These conditions increase the risk to firefighters and reduce the effectiveness of many firefighting tactics (BASF 2003a). Increased fire frequency, fire size, and fire intensity could increase the likelihood that future fires would burn structures, utility corridors, and road corridors that may impact the life and safety of surrounding landowners and the visiting public.

The extent to which firefighter and public life and safety is compromised in future fires would depend on many factors, such as location, weather conditions, communication systems, and timing; however, it would be more difficult to protect people from wildland fire if cheatgrass invasion continues uninterrupted. Increased fire would also mean increased smoke production, which is a known inhalation hazard as well as reduces visibility which results in an increased likelihood of car accidents on smoky roadways.

Cumulative Effects. Implementation of the no action alternative would mean that aerial herbicide application would not occur and the grass-fire cycle would be perpetuated, which would reduce the effectiveness of other projects: yellow star thistle monitoring and control, sensitive plant monitoring and control of non-native species, stabilization of Cabin Spring, and the Pine Valley Peak prescribed fire.

Even under the no action alternative there would be helicopter use on the West Rim Trail projects and the boundary fence reconstruction. The cumulative impacts to health and safety would be short-term, minor, and negative. The increased potential for fire and fire suppression related hazards for the visiting public, park neighbors, and firefighters would result in long-term, minor cumulative negative impacts to public health and safety.

Conclusion. Implementation of the no action alternative would result in no short-term impacts to public health and safety, but would result in long-term, minor negative impacts to public health and safety due to increased exposure to fire and fire suppression hazards resulting from increased fire frequency, fire size, and fire intensity.

Effects of Alternative B – Proposed Action/Preferred Alternative

Under this alternative, a helicopter would be working for approximately 2 weeks in each of the project areas (Dakota & Kolob) to complete the herbicide application. All of the direct hazards associated with this operation would be mitigated. All helicopter work would take place during daylight hours by qualified aircraft and pilot and work/rest requirements would be observed. There would be temporary visitor use restrictions put in place in various sections of the project area to assure that there are no visitors where herbicide is actively being applied or wet chemical exists. The helibase and helispot would be off limits to the public for the duration of the project and all equipment and chemicals would be secured at all times. All label restrictions would be followed, including the proper handling, storage, and mixing of the chemical as well as the use of personal protective equipment.

Indirectly, there are risks that result from the broadcast application of herbicide into the environment. Since visitor use restrictions would be in place to prevent direct exposure to visitors and personal protective equipment would be used to prevent direct exposure to workers, any chemical exposure would most likely be indirect. The most likely route for human exposure to the herbicide is via ingestion of contaminated food or drinking water or body contact with contaminated water used for swimming. The water resources and soils sections of this document already described the pathways by which chemical might enter water bodies, so these pathways are only briefly described in this section. The most likely scenario is for a small percentage of chemical bound to soil particles to be mobilized during summer monsoon rainfall events and washed into main stream channels. Because such events also greatly increase the volume of water in streams, any chemical would be diluted and would move quickly through the river system into larger and larger streams and bodies of water increasing the dilution and decreasing the concentration of the chemical. During flood events that mobilize treated soils into waterways, any imazapic that is not bound to soil would dissolve in water where it would rapidly be photo degraded by sunlight with a half-life in water of less than 8 hours (BASF 2006). As a result of these factors, it is highly unlikely that the chemical would enter drinking water supplies and, because swimming during floods in inherently unsafe and unpopular, it is unlikely that people would be exposed due to body contact. However unlikely there remains the potential for unforeseen direct or indirect exposure to the chemical. Imazapic attacks specific plant enzymes, so its effects on mammals are almost non-existent.

Toxicological studies have found that acute oral, dermal, and inhalation toxicity values are Environmental Protection Agency toxicity category IV (lowest toxicity rating), it is non-irritating to the eye and skin and is not a skin sensitizer (BASF 2005, BASF 2006). Under chronic exposure, imazapic is non-carcinogenic and non-mutagenic (BASF 2005, BASF 2006). It does not bioaccumulate (BASF 2006), so there is no potential for human exposure due to consumption of animals that were exposed to the chemical or animals that ate other animals that were exposed to the chemical.

Glyphosate is considered relatively nontoxic to domestic animals, although ingestion of large quantities of freshly sprayed vegetation may result in temporary gastrointestinal irritation. It is no more than slightly irritating to skin and moderately irritating to eyes. Ingredients in glyphosate are not listed as carcinogenic. And there is no evidence of teratogenicity, mutagenicity, or reproductive effects. Glyphosate is strongly absorbed to soil, with little potential for leaching to ground water. Microbes in the soil readily and completely degrade glyphosate. It tends to adhere to sediments when released to water and does not tend to accumulate in aquatic life (USEPA 2006).

INDUCE® may cause gastrointestinal irritation if ingested in large quantities. It is considered a moderate skin and eye irritant at high concentrations (HHC 2005).

Long-term, the herbicide treatment would interrupt the grass-fire cycle, which would prevent the escalation of fire frequency, fire size, and fire intensity. Studies have found that suppression of cheatgrass with imazapic reduces flame height by as much as 88 percent and minimizes fire spread by as much as 95 percent (BASF 2003a). By restoring the natural fire regime, firefighters, nearby landowners, and the public would not be exposed to the hazards associated with increased fire frequency, fire size, and fire intensity.

Cumulative Effects. The proposed action as well as the boundary fence replacement, and the West Rim Trail work would involve the use of helicopters. To mitigate potential risks, temporary public use restrictions would be enacted to protect public health and safety and all worker safety procedures would be followed.

Overall, impacts of the actions described under the proposed action added to the impacts of other actions affecting public health and safety, would result in short-term, negligible cumulative negative impacts to public health and safety.

Conclusion. All short-term, negative impacts to public health and safety can be mitigated. There would be long-term, minor positive impacts to public health and safety due to restoration of the natural fire regime and reduced exposure of the public, park neighbors, and firefighters to hazards associated with fire and fire suppression activities.

Visitor Use and Experience

Affected Environment

In 2006, over 2.5 million people visited ZION. Visitors participate in a wide range of activities, including lodging and camping (both within the park and in the gateway towns), hiking, canyoneering, rock climbing, attending ranger guided programs, and nature observation. An increasing number of visitors are using ZION's backcountry — in 2006, 6,677 backcountry permits were issued to 27,726 people. Overall, backcountry visitors seek varying degrees of solitude and visitors enjoy natural sounds during most of their experiences.

Visitation varies greatly in the areas affected by the Dakota Hill Complex. There is little to no visitation in the area of the East fire, mainly because of inaccessibility. There are no roads or defined trails or routes to or within the area. The area affected by the West fire includes the West Rim Trail and several popular canyoneering routes. In October 2006, 124 permits for 346 people were issued for overnight use on the West Rim Trail. In November 2006, 47 permits for 99 people were issued. The West Rim Trail also gets some day use. There are four popular canyoneering routes (mostly day use) that are accessed from the areas burned in the West fire: Telephone Canyon, Imlay Canyon, Behunin Canyon, and Heaps Canyon. In October 2006, 34 permits were issued to 133 people for these canyons. In November 2006, 10 permits were issued for 34 people to access these canyons.

The Lava Point hosts a primitive campground with 6 campsites with tables and fire pits, and an outhouse. It is estimated that 250 people stayed in the campground in October 2006. The campground is usually closed the first of November.

Several day and overnight use trails and routes are accessed from the Kolob Terrace Road and Lava Point including: The Subway canyoneering route, Right Fork of North Creek route, Northgate Peaks Trail, West Rim Trail, Wildcat Canyon Trail, and Hop Valley Trail. These areas are used heaviest from June through October. The Subway is the most popular route in the area and is regulated by a permit system. A maximum of 50 people per day can enter the canyon. Use in the area drops off as air temperatures cool. In 2006, there were 214 backcountry permits issued for 651 people to use the Subway Trail and the Right Fork of North Creek in October and 106 backcountry permits issued for 231 people to use the Subway Trail and the Right Fork of North Creek in November.

The Coalpits Wash area is used when air temperatures are cooler. This area is one of the least used areas in the park, with most use occurring during February and March. The Coalpits and Dalton Wash area get some day use, but the use is very small. In October 2006, there were 3 backcountry permits issued for 15 people to use the Coalpits area and no backcountry permits issued for the Coalpits area in November.

Impact Threshold Definitions

Negligible	Visitors would not be affected, or changes in visitor use and/or experience would be below or at the level of detection. The visitor would not likely be aware of the effects associated with the alternative.
Minor	Changes in visitor use and/or experience would be detectable, although the changes would be slight. The visitor would be aware of the effects associated with the alternative, but the effects would be slight.
Moderate	Changes in visitor use and/or experience would be readily apparent. The visitor would be aware of the effects associated with the alternative and would likely be able to express an opinion about the changes.
Major	Changes in visitor use and/or experience would be readily apparent and would have important consequences. The visitor would be aware of the effects associated with the alternative and would likely express a strong opinion about the changes.
Duration	Short-term - occurs only during the treatment effect
	Long-term - occurs after the treatment effect
Area of Analysis	Within and immediately adjacent to the project areas inside the park boundary

Effects of Alternative A – No Action Alternative

Under this alternative, aerial herbicide application would not occur so there would be no temporary public use restriction in the project area and there would be no short-term impact to visitor experience.

However, without the aerial application of herbicide, the grass-fire cycle would continue uninterrupted. As described in the vegetation section of this document, non-native cheatgrass could eventually come to dominate portions of the project area and spread into the surrounding areas, including the more remote interior areas of the park. Fueled by the cheatgrass, fire frequency, fire size, and fire intensity would increase. This would alter the landscape, which would probably be perceived negatively by most visitors as they would lose the opportunity to experience a natural setting, native plant communities, and native wildlife. Furthermore, the increased fire frequency, fire size, and fire intensity would require more frequent public use restrictions while fires are being suppressed and smoke generated by those fires would negatively impact the experience of visitors using other areas of the park or surrounding lands.

Cumulative Effects. Implementation of the no action alternative would mean that aerial herbicide application would not occur and the grass-fire cycle would be perpetuated, which would reduce the effectiveness of other projects: yellow star thistle monitoring and control, sensitive plant monitoring and

control of non-native species, stabilization of Cabin Spring, and the Pine Valley Peak prescribed fire. The increased flammability of the landscape would result in increased potential for public use closures or smoke impacts due to fire or fire suppression activities. This would result in long-term, minor cumulative negative impacts to visitor use and experience.

Even under the no action alternative there would be public closures because of helicopter use in the area of the West Rim Trail. The effect of these closures on visitor use and experience would be short-term, minor and negative.

Conclusion. Implementation of the no action alternative would result in no short-term impacts to visitor use and experience, but would result in long-term, minor negative impacts to visitor use and experience due to public use closures associated with increased fires and fire suppression activities.

Effects of Alternative B – Proposed Action/Preferred Alternative

Under this alternative, a helicopter would be working in the Dakota portion of the project area for approximately 2 weeks in 2007 and in the Kolob portion of the project area for approximately 2 weeks in late 2007 and early 2008 to complete the herbicide application. There would be temporary visitor use restrictions in various sections of the project area to assure that there are no visitors where herbicide is actively being applied. Short-term, such restrictions would negatively impact the visitor experience of those people who are prevented from accessing the area. Furthermore, areas adjacent to the closures would still be open to visitor use but the sight and sound of the helicopter would be apparent to visitors using those areas and would negatively affect their experience**.**

Long-term, the herbicide treatment would interrupt the grass-fire cycle, which would allow native plant communities to regenerate and provide habitat for native wildlife. As the native plant communities and the native wildlife species are routinely cited as a primary attraction for park visitors, their perpetuation would serve to enhance the visitor experience. Furthermore, interruption of the grass-fire cycle would restore natural fire regimes, characterized by infrequent and small fires. This would reduce the negative effects on visitor experience caused by visitor use restrictions during fire suppression operations and smoke impacts to visitors in surrounding areas.

Cumulative Effects. The proposed action as well as the West Rim Trail work, and the Pine Valley Peak prescribed fire would all temporarily restrict public use. While such restrictions would occur in different places and potentially on different days or weeks, the displacement of visitors from these project areas to other areas of the park and surrounding lands would alter visitor use patterns and may negatively affect visitor experience of some visitors. The temporary travel delays and increase in noise levels caused by these projects would also negatively impact visitor experience. Some of these impacts are lessened by the fact that the primary visitor destination, Zion Canyon, would not be directly affected by any of these projects and that visitation is relatively low during the late fall season when these projects would be undertaken.

Overall, impacts of the actions described under the proposed action added to the impacts of other actions affecting visitor use and experience, would result in short-term, minor to moderate cumulative negative impacts to visitor use and experience and long-term, minor cumulative positive impacts to visitor use and experience.

Conclusion. There would be short-term, minor negative impacts to visitor use due to public use closures and long-term, minor positive impacts to visitor experience due to perpetuation of native plant communities and wildlife that visitors can enjoy.

CONSULTATION AND COORDINATION

Agency Consultation

National Historic Preservation Act – In accordance with the NHPA, letters requesting tribal consultation were mailed to the following tribes: Goshute Indian Tribe, Hopi Tribe, Kaibab Paiute Tribe, Las Vegas Paiute Tribe, Moapa Band Paiute Tribe, Northern Ute Tribe, Paiute Indian Tribe of Utah, Pueblo of Zuni, Shivwits Paiute Band, Skull Valley Goshute Tribe, The Navajo Nation, and White Mesa Ute. No comments were received.

State Historic Preservation Office – A letter requesting scoping comments was sent to the State Historic Preservation Office on August 9, 2007. No comments were received. A copy of this document will be sent to the SHPO for review and comment as part of the Section 106 process.

U.S. Fish and Wildlife Service – Park staff prepared a Biological Assessment (BA) as part of section 7 consultation with the USFWS. The USFWS is reviewing the BA. Their concurrence and recommendations will be part of the decision document. Consultation continues and a copy of this document will be sent to the USFWS for their review and comment.

List of Preparers

Name	Title	Project Role
Jock Whitworth	Superintendent	Reviewer and Recommending Official
Kelly Fuhrmann	Fire Ecologist	Prepare Environmental Assessment
Brent Wolfinden	Fire Management Officer	Reviewer
Cheryl Decker	Vegetation Program Manager	Prepare Environmental Assessment
Sarah Horton	Cultural Resource Program Manager	Reviewer
Claire Crow	Wildlife Biologist	Biological Assessment
Kristin Legg	Chief Resource Management & Research	Reviewer
Kezia Nielsen	Environmental Protection Specialist	Prepare Environmental Assessment
Dave Sharrow	Hydrologist	Prepare Environmental Assessment
Rick Inglis	Hydrologist	BAR Plan Watershed Assessment
Elena Robisch	GIS Specialist	GIS Support
Richard Gatewood	BAER Team Leader	BAR Plan
Kara Paintner	BAER Team Vegetation Specialist	BAR Plan Vegetation Assessment
Ken Holsinger	BAER Team Vegetation Specialist	ES Infrastructure Assessment & BAR Vegetation Assessment
Dave Roemer	BAER Team Wildlife Biologist	ES and BAR Wildlife Assessment & Biological Assessment
Nell Blodgett	BAER Team and Zion NP GIS Specialist	ES and BAR Maps
Cynthia Wanschura	BAER Team and Zion NP GIS Specialist	ES and BAR Maps
Lisa Hanson	NEPA and Section 106 Specialist	Regional Office Reviewer

List of Agencies, Governments, Officials, and Organizations Contacted

Federal Agencies

Bureau of Land Management – Kanab Field Office
Bureau of Land Management - St. George Field Office

National Park Service - Utah State Coordinator
U.S. Fish and Wildlife Service
U.S. Geological Survey
Natural Resources Conservation Service

State and Local Agencies and Governments

Five County Association of Governments
Kane County Commissioners
Kane County Water Conservancy District
Mayor of Rockville, UT
Mayor of Springdale, UT
Mayor of Hurricane, UT
Mayor of La Verkin, UT
Mayor of St, George, UT
Mayor of Kanab, UT
Mayor of Orderville, UT
Utah Department of Agriculture & Food
Utah Division of Wildlife Resources
Utah Office of the Governor
Utah School and Institutional Trust Lands Administration
Utah State Clearinghouse
Utah State Historic Preservation Officer
Washington County Commissioners
Washington County Water Conservancy District

State and Federal Elected Officials

Congressman Jim Matheson
Senator Robert Bennett
Senator Orrin Hatch
Stephen Urquhart – Utah House of Representatives
David Clark – Utah House of Representatives
Bradley Last – Utah House of Representatives
DeMar Brown – Utah House of representatives
Dennis Stowell – Utah State Senate
John Hickman – Utah State Senate

Indian Tribes

Goshute Indian Tribe
Hopi Tribe
Kaibab Paiute Tribe
Las Vegas Paiute Tribe
Moapa Band Paiute Tribe
Northern Ute Tribe
Paiute Indian Tribe of Utah
Pueblo of Zuni
Shivwits Paiute Band
Skull Valley Goshute Tribe
The Navajo Nation

White Mesa Ute

Organizations

Grand Canyon Trust
Southern Utah Wilderness Alliance
The Nature Conservancy
Sierra Club
Zion Canyon Chamber of Commerce
Virgin River Resource Management & Recovery Program

REFERENCES

Agriliance, LLC. 2005. Material Safety Data Sheet for Rascal® Herbicide. 2 pp. **www.agriliance.com**

Agriliance, LLC. 2005. Rascal® Specimen Label. 94 pp. **www.agriliance.com**

BASF. 2003a. A Burning Issue: Cheatgrass fuels rangeland fires. 12 pp.

BASF. 2003b. Cheatgrass: Non-native cheatgrass cheats farmers and ranchers out of their land. Technical Bulletin. 8 pp.

BASF. 2004. Plateau® Specimen Label. 16 pp. **www.vmanswers.com**

BASF. 2005. Material Safety Data Sheet for Plateau® Herbicide. 8 pp. **www.vmanswers.com**

BASF. 2006. Plateau® Herbicide: Toxicology, Ecotoxicology, and Environmental Fate Overview. 8 pp.

Barney, M.A., and N.C. Frischknecht. 1974. Vegetation Changes Following Fire in the Pinyon-Juniper Type of West Central Utah. Journal of Range Management. 17:91-96.

Belnap, Jayne, Julie H. Kaltenecker, Roger Rosentreter, John Williams, Steve Leonard and David Eldridge. 2001. Biological Soil Crusts: Ecology and Management. U.S. Bureau of Land Management, National Science and Technology Center, Technical Reference 1730-2, Denver, Colorado. 109 pp.

Brooks, M.L., C.M. D'Antonio, D.M. Richardson, J.B. Grace, J.E. Kelley, J.M. DiTomoso, R.J. Hobbs, M.Pellant, and D. Pyke. 2004. Effects of Invasive Alien Plants on Fire Regimes. Bioscience Vol. 54 No. 7, pp 677-688.

Brooks, M.L. 2005. Effectiveness of Postfire Seeding to Reduce Cheatgrass (*Bromus tectorum*) Growth and Reproduction in Recently Burned Sagebrush Steppe. Final Report for JFSP Project Number 01C-3-3-13. Delivered to the Joint Fire Science Program, National Interagency Fire Center, 3833 S. Development Ave., Boise, ID 83705-5354. 7 pages.

Bunting, S.C. 1987. Use of Prescribed Burning in Juniper and Pinyon Juniper Woodlands, p. 141-144. In: R.L. Everett (ed.). Proceedings-Pinyon-Juniper Conference. USDA Forest Service General Technical Report INT-215.

Campbell, R.B., Chappell, L., Greenhalgh, K. 2003. Personal communication, data from unpublished Fishlake National Forest Wildland Fire Use Plan. Table 16: Analysis by Vegetation Cover Type for the Combination of all Subsections for the Fishlake National Forest. Richfield, UT 84701 As Referenced by: Merzenich, J. and L. Frid. 2005. Projecting Landscape Conditions in Southern Utah Using VDDT. In: M. Bevers and T.M. Barrett (comps.). 2005. Systems Analysis in Forest Resources: Proceedings of the 2003 Symposium; October 7-9, Stevenson, WA. General Technical Report PNW-GTR-000. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. pp. 157-163.

Cogan, D., M. Reid, K. Schulz, and M. Pucherelli. 2004. Zion National Park Vegetation Mapping Project, Final Report and Map. Technical Memorandum 8260-03-01, Remote Sensing and GIS Group, Technical Service Center, Bureau of Reclamation, Denver, Colorado.

D'Antonio, C.M. and P.M. Vitousek. 1992. Biological Invasions by Exotic Grasses, the Grass/Fire Cycle, and Global Change. Annual Review of Ecology and Systematics 3: 63-87

Esque, T.C., S. VanderWall, C.R. Schwalbe, P.A. Medica, and R.H. Webb. 2004a. Effects of Fire on Small Animals and the Potential for Animals to Facilitate Restoration in Hot Desert Environments. Northwest Science Association Symposium. Session on: Fire and Hazardous Fuel Reduction. Ellensburg, WA.

Esque, T.C., L.A. DeFalco, S.J. Scoles, D.F. Haines, R.L. Kipp, and J.E. Rodgers. 2004b. Survivorship of Joshua Trees (Yucca brevifolia) in a Harsh Desert Environment: Effects of Fire, Drought, and Herbivory in Joshua Tree National Park. 16-18 November. Mojave Desert Science Symposium. University of Redlands, CA.

Everett, R. L. 1987. Proceedings-Pinyon-Juniper Conference. General Technical Report INT-215. U.S. Forest Service Intermountain Research Station, Ogden. UT, 581 pp.

Executive Office of the President, Council on Environmental Quality (CEQ). 1978. Regulations for implementing the procedural provisions of the National Environmental Quality Act. Code of Federal Regulations Title 40, Parts 1500-1508. Washington, D.C.

Executive Office of the President, CEQ. 1981. Forty most asked questions concerning CEQ's National Environmental Quality Act regulations (40 CFR 1500-1508). Federal Register 46 (55):18026-18038.

Harris, G.A., and C.J. Goebel. 1976. Factors in Plant Competition in Seeding Pacific Northwest Ranges. Washington State University, Agricultural Experiment Station. Bulletin 820.

Jameson, D.A., J.A. Williams, and E.W. Wilton. 1962. Vegetation and Soils of Fishtail Mesa, Arizona. Ecology 43:403-410.

Helena Holding Company (HHC). 2005. INDUCE® Material Safety Data Sheet.
www.helenachemical.com/Specialty/label.html

Helena Holding Company. 2005. INDUCE® Specimen Label.
www.helenachemical.com/Specialty/label.html

Hobbs, Chris and Micah Downing. 2003. The Natural Soundscape in Zion National Park, Wyle Report WR03-08. Wyle Acoustic Group, Wyle Laboratories, Arlington, Virginia.

Kidd, H. and James, D.R., Eds. 1991. The Agrochemicals Handbook, Third Edition. Royal Society of Chemistry Information Services, Cambridge, UK.

Klemmedson, J. 0. and J. G. Smith. 1964. Cheatgrass (*Bromus tectortum*). Botanical Review 30:226-262.

Kury, B.K, J.D. Alexander, and J. Vollmer. 2002. Data Collection and Fire Modeling Determine Potential for the use of Plateau® Herbicide to Establish Fuel Breaks in *Bromus tectorum*-Dominated Rangelands. 2002 Association of Fire Ecology Annual Conference. San Diego, CA. December 3-5.

Louie, D.L., and M.L. Brooks, C. Deuser, and J. Passek. 2005. Evaluate Treatments to Reduce Hazardous Fine Fuels Created by Non-native Plants in Zion Canyon. A proposal for the Joint Fire Science Program, AFP 2005-2-Task 1 Project # 05-2-1-13.

Meyer, S.E. 2003. How Cheatgrass Won the West. Presentation at Wyoming Bureau of Land Management Cheatgrass Symposium.

Monaco, T.A., T.M. Osmond, and S.A. Dewey. 2005. Medusahead Control with Fall- and Spring-Applied Herbicides on Northern Utah Foothills. Weed Technology Volume 19:653–658

Mosley, J. C., S. C. Bunting, and M. E. Manoukian. 1999. Cheatgrass in R. L. Sheley and J. K. Petroff, eds. Biology and Management of Noxious Rangeland Weeds. Oregon State University Press, Corvallis.

National Park Service (NPS). 2001a. Director's Order-12 and Handbook, Conservation Planning, Environmental Impact Analysis, and Decision Making. Washington, D.C.

NPS. 2001b. Zion National Park. General Management Plan.

NPS. 2002a. Director's Order-77-1, Wetland Protection. Washington, D.C.

NPS. 2002b. Director's Order-18 and Reference Manual, Wildland Fire Management. Washington, D.C.

NPS. 2005. Wildland Fire Management Plan EA/FONSI. Zion National Park, Springdale, Utah.

NPS. 2006a. Kolob Fire Burned Area Rehabilitation Plan. Zion National Park, Utah.

NPS. 2006b. Management Policies 2006. Washington, D.C.

NPS. 2007. Dakota Hill Complex Burned Area Rehabilitation Plan. Zion National Park, Utah.

Pellent, M. 2003. Lessons from the Great Basin. Presented at the Wyoming Cheatgrass Conference 2003.

Rinkevich, S. E. 1991. Distribution and Habitat Characteristics of Mexican Spotted Owl in Zion National Park, Utah. M.S. Thesis, Humboldt State University, Arcata, CA. 62 pp.

United States Department of Agriculture (USDA). Soil Conservation Service. 1977. Soil Survey of Washington County Area, Utah. 94 pp.

United States Department of the Interior, Department of Agriculture, Department of Energy, Department of Defense, Department of Commerce, Environmental Protection Agency, Federal Emergency Management Agency, and National Association of State Foresters. 2001. Review and Update of the 1995 Federal Wildland Fire Management Policy.

United States Environmental Protection Agency (USEPA). 1992. Pesticide tolerance for glyphosate. Federal Register. Volume 57, No. 49, pages 8739-8740.

United States Fish and Wildlife Service (USFWS). 1995. Recovery Plan for the Mexican Spotted Owl: Vol. 1. Albuquerque, New Mexico.

USFWS. 1996. Endangered and Threatened Wildlife and Plants: Establishment of a Nonessential Experimental Population of California Condors in Northern Arizona; Final Rule. 50 CFR Part 17. Federal Register, Vol. 61 No. 201, Wednesday October 16, 1996, pages 54043-54060.

USFWS. 1999. Endangered and Threatened Wildlife and Plants; Final Rule to Remove the American Peregrine Falcon From the Federal List of Endangered and Threatened Wildlife, and to Remove the

Similarity of Appearance Provision for the Free-Flying Peregrines in the Conterminous United States; Final Rule. 50 CFR Part 17. Federal Register, Vol. 64 No. 164, Wednesday August 25, 1999, pages 46542-46558.

USFWS. 2000. National Wetlands Inventory Maps. 20 USGS Quadrangles of enhanced NWI mapping of Zion National Park and vicinity.

USFWS. 2001. Endangered and Threatened Wildlife and Plants; Determination of Endangered Status for *Astragalus holmgreniorum* (Holmgren milk-vetch) and *Astragalus ampullarioides* (Shivwits milk-vetch); Final Rule. Federal Register, Vol. 66, No. 189, pages 49560-49567.

USFWS. 2004. Endangered and Threatened Wildlife and Plants; Final Designation of Critical Habitat for the Mexican spotted owl; Final Rule. 50 CFR Part 17. Federal Register, Vol. 69, No. 168, Tuesday, August 31, 2004, pages 53182-53233.

USFWS. 2005. Formal Section 7 Consultation for the Environmental Assessment for the Zion National Park Fire Management Plan. Utah Field Office US Fish and Wildlife Service, Ecological Services, West Valley City, Utah.

USFWS. 2006. *Astragalus holmgreniorum* (Holmgren milk-vetch) and *Astragalus ampullarioides* (Shivwits milk-vetch) Recovery Plan. September 2006.

USFWS. 2006. Endangered and Threatened Wildlife and Plants; Designation of Critical Habitat for *Astragalus holmgreniorum* (Holmgren milk-vetch) and *Astragalus ampullarioides* (Shivwits milk-vetch); Final Rule. 50 CFR Part 17. Federal Register, Vol. 71, No. 248, Wednesday, December 27, 2006, pages 77972-78012.

Weed Science Society of America. 1994. Herbicide Handbook, Seventh Edition. Champaign, IL, pages 10-59.

Welsh, S.L., N. D. Atwood, S. Goodrich, and L.C. Higgins. 1993. A Utah Flora, Second Edition, revised. Brigham Young University, Provo, Utah.

West, N.E., and W.C. Loope. 1977. Annual Report to Zion National Park on Studies of Fire Frequency in Backcountry Ecosystems of Zion National Park. Zion National Park, Utah.

Zouhar, Kris. 2003. *Tamarix spp*. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). Available: http://www.fs.fed.us/database/feis/ [2006, July 20].

GLOSSARY and ACRONYMS

Annual Plant – A plant growing from seed, producing flowers and seeds, and dying the same year.

Backcountry – Zion backcountry constitutes most of the undeveloped area of the park, where no roads or substantial human-made structures exist. Much of Zion's backcountry, however, does contain maintained trails. Primary backcountry travel is by foot, and on specified trails, by horseback. Camping is regulated in the backcountry: in some areas camping is allowed nearly anywhere, while in other areas camping is only permitted in designated campsites.

Base Flow – River or spring flow that is low and steady, typically from the discharge of groundwater and not as a result of recent precipitation.

Biological Soil Crusts – Where the soil surface is bound together by a community of organisms that can include cyanobacteria, algae, fungi, mosses and lichens. These create a soft crust at the soil surface that is resistant to raindrop impact, erosion from wind and water, and its roughness greatly increase the soil's ability to capture and hold water.

Canyoneering – Hiking and rappelling through narrow canyons. In Zion, permits are issued for canyoneering routes requiring the use of rappelling equipment.

Class I Area – Lands designated through the Clean Air Act, including National Parks and Wilderness, that are given the highest protection of existing air quality (prevention of significant deterioration), and where visibility and other air quality related values are protected.

Cool Season Plant Species – A plant that makes most of its growth during winter and spring and sets seed in late spring or early summer.

Cumulative Impacts – The impacts of cumulative actions - includes impacts of actions in the past, the present, and the reasonable foreseeable future.

Desired Future Conditions – The goals or end results park managers are striving to achieve. Desired conditions can be set for park resources, visitor experiences, management activities, and facilities. Desired conditions reflect the park's purpose and mission goals, and ensure that Zion's resources are conserved and quality experiences are provided.

Direct Effect – An impact that occurs as a result of the proposed action or alternative in the same place and at the same time as the action.

Ecosystem Sustainability – Perpetuation of the biological, cultural, and physical processes such that dependent resources are maintained in high condition within a natural range of variability.

Environmental Assessment – Environmental assessments were authorized by the National Environmental Policy Act (NEPA) of 1969. They are concise, analytical documents prepared with public participation that determine if an Environmental Impact Statement is needed for a particular project or action. If an environmental assessment determines an environmental impact statement is not needed, the environmental impact statement becomes the document allowing agency compliance with NEPA requirements.

Environmental Impact Statement – Environmental impact statements were authorized by the National Environmental Policy Act (NEPA) of 1969. Prepared with public participation, they assist decision makers by providing information, analysis and an array of action alternatives, allowing managers to see the probable effects of decisions on the environment. Generally, environmental impact statements are written for large-scale actions or geographical areas.

Extirpated – When a species no longer exists in the wild in a certain place, but exists elsewhere.

Fire Frequency – The return interval or recurrence interval of fire in a given area over a specific time.

Fire Intensity – A general term relating to the heat energy released by a fire.

Fire Management Plan (FMP) – A strategic plan that defines a program to manage wildland and prescribed fires and documents the Fire Management Program in the approved land use plan. The plan is supplemented by operational plans such as preparedness plans, preplanned dispatch plans, prescribed fire plans and prevention plans.

Fire Regime – The combination of fire frequency, predictability, intensity, seasonality and size characteristics of fire in a particular ecosystem.

Fire-Return Interval – The number of years between two successive fire events at a specific site or an area of a specified size.

Floodplain – Part of a river channel that is inundated only during time of high flow. A 100-year floodplain is the area inundated by a flood that has a 1% chance of occurring in any given year, or occurs on average once every 100 years. Floods of this magnitude occur frequently enough to pose a serious threat to facilities and people.

Fuel – Combustible material. Includes, vegetation, such as grass, leaves, ground litter, plants, shrubs, and trees that feed a fire.

Fuel Type – An identifiable association of fuel elements of a distinctive plant species, form, size, arrangement, or other characteristics that will cause a predictable rate of fire spread or difficulty of control under specified weather conditions.

Grass-Fire Cycle – An alteration of fire regime that may occur where nonnative invasive grass species dominate the herbaceous layer in a plant community. The process occurs in this way: The nonnative grass colonizes an area and provides a continuous fine fuel that is readily ignited and facilitates fire spread. Larger and perhaps more intense fires then occur more frequently in the invaded area than in similar, uninvaded communities. Following these grass-fueled fires, nonnative grasses typically recover more rapidly than native species, further increasing the probability of fire and the possibility of greater fire size, greater fire intensity, and decline of native species.

Herbicide – Any chemical substance used to control plant growth.

Impact Topics – Specific natural, cultural, or socioeconomic resources that would be affected by the proposed action or alternatives (including no action). The magnitude, duration, and timing of the effect to each of these resources are evaluated in the impact section of the environmental assessment.

Indirect Impact – Reasonably foreseeable impacts that occur removed in time or space from the proposed action. These "downstream" impacts, future impacts, or the impacts of reasonably expected connected actions (e.g., growth in an area after a highway is completed).

Issue(s) – In NEPA, issues are environmental, social, and economic problems or effects that may occur of the proposed action or alternatives (including no action) are implemented or continue to be implemented.

Invetebrate – Any animal without a backbone or spinal column; any animal other than a fish, amphibian, reptile, bird, or mammal.

LD_{50} – Standardized measure for expressing and comparing toxicity of chemicals. It is the dose that kill half (50 percent) of the animals tested (LD=lethal dose).

Litter – Top layer of the forest, scrubland, or grassland floor, directly above the fermentation layer composed of loose debris of dead sticks, branches, twigs, and recently fallen leaves or needles, little altered in structure by decomposition.

Management Zones – In the Visitor Experience and Resource Protection Plan, identify how different areas in the park will be managed to achieve a combination of desired conditions. Each zone represents a unique combination of physical, biological, social, and managerial conditions.

Mutagenic – Any agent or substance capable of noticeably increasing the frequency of mutations.

National Environmental Policy Act (NEPA) – NEPA is the basic national law for protection of the environment, passed by Congress in 1969. It sets policy and procedures for environmental protection, and authorizes Environmental Impact Statements and Environmental Assessments to be used as analytical tools to help federal managers make decisions.

Natural Sound and Soundscape – Any sounds produced by nature, such as the wind in the trees, songs of birds, flow of water in rivers and streams, etc. Unnatural sound would include any sounds produced by people or their devices, such as human voices, vehicles, and motorized tools.

Non-native Plant – A plant that is not native to the area, exotic.

Perennial Plant – Plants living more than two years.

Rehabilitation – The activities necessary to repair damage or disturbance caused by wildland fires or the fire suppression activity.

Riparian – Adjacent to, or living on, the bank of a river, or sometimes a lake or pond.

Scoping – Internal NPS decision-making on issues, alternatives, mitigation measures, the analysis boundary, appropriate level of documentation, lead and cooperating agency roles, available references and guidance, defining purpose and need, and so forth. External scoping is the early involvement of the interested and affected public.

Slickrock – Flat areas or, more commonly, slopes with large exposures of bare rock. This is typically on exposures of Navajo sandstone in Zion.

Teratogenic – An agent, as a chemical, disease, etc., that causes malformation of a fetus.

Warm Season Plant Species – A plant that makes of its growth during spring and summer and sets seed in late summer or early fall. It is normally dormant in winter.

Watershed – The area drained by a river or river system.

Wildland – Any natural landscape not maintained for buildings, road, fence or other human development.

BAER	Burned Area Emergency Response
BAR	Burned Area Rehabilitation
BLM	Bureau of Land Management
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
cfs	Cubic Feet per Second
dBA	A-Weighted Decibels
DFC	Desired Future Condition
DO	Director's Order
EA	Environmental Assessment

ES	Emergency Stabilization
ESA	Endangered Species Act
FMP	Fire Management Plan
GMP	General Management Plan
mg/l	milligrams per liter
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NPS	National Park Service
NRHP	National Register of Historic Places
NWI	National Wetland Inventory
SHPO	State Historic Preservation Officer
TSD	Total Dissolved Solids
USC	United States Code
USDI	U.S. Department of the Interior
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
ZION	Zion National Park

Appendix 1

Scoping Letter

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United States Department of the Interior

NATIONAL PARK SERVICE
Zion National Park
Springdale, Utah 84767

IN REPLY REFER TO: L7617 & Y1823 (ZION RM&R)

August 9, 2007

Dear Interested Party:

Zion National Park is preparing an Environmental Assessment (EA) to assess the impacts of the aerial application of herbicide on the area burned in the Dakota Hill Fire Complex. The fire complex included two lightning-caused fires that started on July 15, 2007 and burned 5,890 acres within the park. The west fire burned about 2,000 acres on the southern end of Horse Pasture Plateau and the east fire burned over 3,700 acres north of Orderville Canyon. The EA will also analyze additional herbicide treatments to approximately 10,000 acres burned in June 2006 Kolob Fire (Refer to attached map). Because of the remote and rough terrain in the burn area, helicopter application of the herbicide is proposed.

The proposed aerial application of herbicide is intended to interrupt the grass-fire cycle that is perpetuated by cheatgrass, a non-native, highly flammable grass. Cheatgrass increases in abundance and density after fire. As cheatgrass continues to invade and increase after each fire, the time between fires becomes shorter. Since the native shrubs and trees are slower to re-establish after fire and need many years between fire events to complete their lifecycles, the increased fire frequency fueled by cheatgrass eventually eliminates the native shrubs and trees from the landscape.

A treatment is needed to interrupt the grass-fire cycle that has already been established, but has not yet eliminated the native seed from the soil. The National Park Service (NPS) proposes to treat the burned area with the herbicides Plateau and Roundup. Plateau targets cheatgrass seed before germination: reducing the growth of cheatgrass which reduces the fine fuels that carry wildland fires. Plateau has shown a very low toxicity to humans, fish and wildlife, and does not remain in the soil. Roundup is a non-selective post-emergence herbicide which works by foliar uptake and completely biodegrades within 21 days. It is practically non-toxic to humans and wildlife and moderately toxic in the first 96 hours to aquatic life forms. In order to mitigate any impacts to aquatic life, a ¼ to ½ mile no-spray buffer along all streams will be part of the proposed action.

The NPS welcomes your comments, suggestions, and other input concerning this project to help us identify issues of concern and to ensure that the EA thoroughly addresses potential impacts from the proposal. Please submit written comments by August 23, 2007 to: Dakota Hill Fire Complex Rehabilitation, Zion National Park, Springdale, UT 84767.

Before including your address, phone number, e-mail address, or other personal identifying information in your comment, you should be aware that your entire comment - including your personal identifying information - may be made publicly available at any time. While you can ask us in your comment to withhold your personal identifying information from public review, we cannot guarantee that we will be able to do so.

Sincerely,

Jock F. Whitworth, Superintendent